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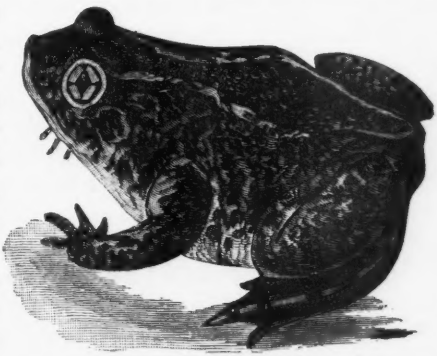
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RECENT STUDIES OF THE SPADE-FOOT TOAD.

BY CHARLES C. ABBOTT, M.D.

IN a sink-hole in a dry upland field near Trenton, New Jersey, on April 10, 1884, there suddenly appeared a large colony of hermit spade-foot toads (*Scaphiopus holbrooki*), which, by their remarkable cries, attracted the attention of every one passing by. So unlike the cries of any other of our batrachians were their utterances, that all who heard them were attracted to the spot, and wondered, when they saw the animals, that so great a volume of sound could issue from so small an animal. One need not wonder, however, on this point if they will but examine the development of the animal's vocal cords. The machinery for producing sounds equal to an ordinary steam whistle are apparently contained in the throat of this rare and curious batrachian. Holbrook, in his diagnosis of the genus Scaphiopus, refers to the "sub-gular vocal sac" of the males; but it must not be inferred that the females are voiceless. That they are not so noisy is probable, but occasion requiring, they can readily make themselves heard.



Scaphiopus holbrooki.

These spade-foots remained in the shallow waters of this sink-

hole until April 15, when the weather becoming considerably cooler, they as suddenly disappeared as they had come. In May, 1874, these toads appeared in like manner in the same locality, remained but a few days and were gone. In the intervening ten years not a specimen was seen or heard, although careful search, annually, was made. I supposed, when they appeared in April of the present year, that they spawned previous to their sudden disappearance, but neglected to investigate the matter in consequence of a press of work in other lines of investigation. The spade-foot toads were soon forgotten. The wealth of bird-life that came trooping in from the South during May, and their subsequent nesting, occupied my thoughts and were the prominent objects sought during my daily rambles.

It was not long, however, before the spade-foots again became the prominent feature of the fauna of the neighborhood. During the night of June 25–26 a violent north-east storm arose, and rain fell in torrents. The sink-hole, which for weeks had been nearly dry, was again flooded, and on the afternoon of the 26th was literally alive with these rare toads. Sitting upon every projecting stick or tuft of grass, or swimming with their heads above the surface of the water, were spade-foots by the hundred, and every one apparently uttering those shrill, ear-piercing groans that only these batrachians can utter. Not only during the day but all night their cries were kept up. The following day there was no abatement, but during the night the sound decreased. On the morning of the 28th not an individual was to be seen or heard.

During this brief interval these animals spawned, the eggs being attached to blades of grass and slender twigs. These eggs hatched on the 2d of July and a large series were gathered a week later.

To return to the eggs. During the time that intervened from the laying of the eggs until I gathered specimens of the tadpoles, there occurred four moderately heavy showers, so that the water in the sink-hole at no time disappeared, but was much below the level that it reached during the protracted rain-fall of June 26. Very much, therefore, of the spawn that was laid was high and dry for from two to four days before hatching, and I suppose was destroyed.

On the evening of July 9 I found the water in the sink-hole

confined to a few very shallow pools of limited area, and in these pools were a few hundreds of Scaphiopus tadpoles. In comparison with the abundance of eggs seen June 26, and of young seen a week later, it is evident that a large portion of the eggs were destroyed and a vast number of very young tadpoles were killed by the soaking away of the water.

I have never known any like disparity between the eggs of frogs or common toads and the young in the tadpole state; and it is at once very evident that if the spade-foot toads habitually or usually deposit their eggs in temporary pools, then we have an obvious reason for the positive rarity of the animal, as apparently it is the rule, rather than the exception, for the egg to be destroyed or the young perish.

The tadpoles gathered July 9, which were then seven days old, were curious creatures. At this time the hind legs were well developed, although small, and did not interfere with the animal's natatorial locomotion. The bodies of these young Scaphiopi were short, stout and oval, and, when viewed in the water, deep velvety black; but when closely examined it was found that the two irregularly parallel yellow dorsal stripes, that are so prominent a feature in the coloration of the adult male, were plainly discernible.

The movements of these tadpoles were not different from that of the young frogs and toads in this stage of their existence. Those that I had in an aquarium moved in companies as though following a leader, and occasionally one would drop out of the ranks, come quickly to the surface, eject a bubble of air, and dive again quickly to the bottom of the tank. Like all tadpoles they had enormous appetites, and when fed with bits of raw meat quickly attached their sucking mouths to the food offered, and did not remove it, I think, while a particle of blood remained in the mass.

A week later, July 16, the majority of these tadpoles had acquired their front legs, and the tail had perceptibly diminished in size, but still was used by them when moving through the water. At this time, however, the movements of the animal are far less active than before or soon after, and for a few days, if exposed to the attacks of any enemies, would suffer far more than at any other period of their lives.

A very curious feature in the growth of these animals is now

to be noticed. Of the specimens I had under examination, in an aquarium, about five per cent did not progress beyond the condition in which all were in July 9. These "retarded" tadpoles proved to be voracious cannibals. They seized their more matured companions by their tails and legs, swallowing the member and thus sustaining their own lives at the expense of their fellows. They generally killed their victim in the course of twenty-four hours, and often in less time, and then promptly seized another. So bloodthirsty were these few "retarded" tadpoles that I was compelled to protect the lives of the little hoppers, their brethren, which now, in spite of stumps of tails, sat in frog-like fashion on their haunches, and were in all respects miniatures of the adult spade-foots that in April and June made night hideous with their unearthly cries.

Having tested several specimens, a few days previously, as to their ability to assume the land-life of adult Scaphiopi, by placing them upon damp sand, and finding that they throve fairly well, on the 25th of July I removed the water in the aquarium and put in earth to about an inch in depth, and very carefully smoothed the surface. Upon this the young spade-foots were placed, and in less than one minute many had commenced digging little burrows, into which they disappeared as the excavations deepened. In all respects these burrows were like those made by adult spade-foots, oval in outline, oblique in direction, and generally with a slight angle in the course. In twenty minutes all but two, of forty-four specimens, were below the surface of the earth stratum I had placed in the aquarium.

It now became monotonous in the extreme to watch them. Not a movement occurred that was other than might be expected of adult toads or frogs of any species.

I did not see them eat, but as only living food would now be accepted by them, it was simply because minute insect life did not come within reach; but while yet in the water these young spade-foots found some food, as shown by the examination of the stomachs and intestines of several specimens. Dr. A. C. Stokes kindly made this examination, at my request, and reported as follows: In the stomach of one was found fragments of a fly and of a small moth, and in the intestine a mass of sand grains cemented together by dark brown amorphous matter, with numerous rhizopods (Arcella) and several diatoms. In the stomach of another a species of Thrips, and a few diatoms in the intestine.

These two species had been thirty-six hours out of the water when the examination was made.

During this simple series of observations of young Scaphiopi in confinement, I watched also the development of those left in the sink-hole. The water there soon was confined to mere puddles concealed in the dead leaves, and before the young had their limbs fully developed the depth was nowhere sufficient to permit of swimming. Three days in advance of the maturing of my confined specimens, I saw, in the sink-hole, a few individuals which had fairly assumed the land-living, air-breathing stage of existence. Supposing that, like those I had at home, they would burrow in the earth *where they were*, I did not visit the locality from the 21st to the 31st of July, on which date I made an exhaustive but unsuccessful search for them. Not a trace of either young or adult could I discover. It cannot be said that they were overlooked. My search was too careful and comprehensive for this, and I believe that these spade-foots, both old and young, wander farther from their breeding grounds than is supposed, or else dig far deeper into the earth than a depth of six or eight inches, as stated by Holbrook and DeKay.

I have already referred to the wonderful noises made by these animals when they congregate in pools for the purpose of spawning. At no other time do they appear to be vocal, and the question naturally arises, why, when the animal leads a life that requires no such power except for two or three days in a year, should its utterances be far louder than any or all the frogs and toads of the same locality combined? Although the animal is strictly crepuscular and not diurnal, it could readily find a mate guided by sight, and the purpose of the deafening epithalamium is somewhat hard to determine. If it could be shown that they call to each other from far distant points, the difficulty would disappear, but this they are not known to do. Apparently it is not until they are congregated in some available pool that they sing, if singing it can be called. No words yet in use in our language can fairly describe their utterances, which, it may be presumed, are expressions of delight at meeting.

A word in conclusion with reference to the peculiar spur-like process which gives the common name to this batrachian. Holbrook describes it accurately as follows: "On the internal margin of the metatarsus is a horny spade-like process, containing a

bone, which moves by an imperfect joint: the breadth of this process is about a line and a half, its length one line; the cutting edge is jet black." Fig. 1 represents the left foot of an adult specimen, seen from beneath, and showing the "spade." It will also be noticed that the little toe terminates also in a horny knob, a fact which has hitherto, I believe, been overlooked.



Fig. 1.—Nat. size.



Fig. 2.—×10.

FIG. 1.—Inside of adult left foot, natural size. FIG. 2.—Left foot of young, showing spur at earliest stage of growth.

I have already mentioned how quickly the young hoppers dug little tunnels for themselves when placed upon the earth. At that early age the growth of the "spade" had commenced, as will be seen by the drawing, Fig. 2. This is now a white, soft, cartilaginous process, differing greatly from the same feature on an adult foot. It can scarcely be of use in digging, at this time, and so leads us to infer that the young choose more yielding earth and remain nearer the surface than do the adult spade-foots. In such a case the older the creature and better developed the spade, the deeper are the subterranean homes wherein they seem to remain so closely, and from which, moved by some common impulse, they mysteriously come forth, in multitudes, to startle the passer-by with their weird cries, and then as suddenly to disappear, no one knows where.

NOTICES OF SOME NEW PARASITIC INFUSORIA.

BY ALFRED C. STOKES, M.D.

WHILE making a microscopical examination of the intestinal and stomach contents of young spade-foot hermit toads (*Scaphiopus holbrooki*), whose life-history Dr. C. C. Abbott is studying, I observed two forms of apparently undescribed endoparasitic Infusoria so crowding the rectum that it seemed only a thin walled tube surrounding a semi-solid, writhing mass which, viewed with a low power objective, brought to mind the idea of a shimmering cloud of heated air, or a wavering flame of colorless fire, through which here and there glistened a yellow spark.

The rectum of toads and frogs has long been a kind of happy hunting ground for endoparasites, especially for the Opalinæ; but so far as I am aware only colorless species of the genus have been observed. In this instance, however, the yellow points within that living mass proved to be Opalinæ of a lemon-yellow tint. The periphery and, to a much less extent, the deeper portion of the endoplasm are tinged, the color, which appears to be a stain and not an aggregation of particles, being collected in a layer near the cuticular surface, with a quite sharply defined line of demarkation between the lower margin and the internal body-sarcode.

The infusorian is broadly ovate, soft and flexible and somewhat changeable in shape, assuming at will a subpyriform or subglobose figure. The surface is indented by obliquely disposed striæ which bear the long and fine vibratile cilia clothing the creature. Scattered through the endoplasm are numerous refringent corpuscles mingled with many larger spherical bodies having the aspect of vacuoles. The former may be portions of the nucleus, as that constituent is known to break into corpuscular parts with age, and to become scattered as the infusorian matures. Nothing else corresponding to an endoplast was observed, even after using reagents. There is no trace of a mouth. Nutriment is probably absorbed from the intestinal fluids in which the animalcule delights to live. The contractile vesicle is also absent.

Its numbers are not great; perhaps a dozen were noted in the contents of the rectum. Neither is it always to be found. Compared with its more numerous associates, however, this yellow creature is a giant among pygmies, and it rotates through the

mass with a carelessness as to results quite in keeping with its bulk. It measures from $\frac{1}{85}$ to $\frac{1}{35}$ inch in length.

On account of the color it may be named *Opalina flava*, and the following description, in connection with its habitat within the rectum of the rarest of our batrachians, will probably be sufficient for its identification. It is shown in Fig. 1 magnified about 235 diameters:



X235

FIG. 1.—*Opalina flava*, sp. nov.

Opalina flava, sp. nov.—Body ovate, inflated, often as long as broad, or subpyriform, widest and rounded posteriorly, the length once and one-half to twice the breadth; the right and left hand borders evenly rounded; striations of the cuticular surface obliquely disposed and bearing the long, fine, vibratile cilia; nuclei (?) numerous, small, scattered; sarcode enclosing many refractile corpuscles and larger spherical bodies apparently vacuolar; contractile vesicle none; parenchyma lemon-yellow, the color darkest near the periphery, where it is disposed in a layer, the central portion of the sarcode being comparatively colorless. Length, $\frac{1}{330}$ to $\frac{1}{350}$ inch. Habitat, the rectum of the spade-foot hermit toad, *Scaphiopus holbrooki*.

The intestinal fluid seemed thickened by the throng of bacteria, bacilli, vibriones and spirilla accompanying the Opalinæ; and associated with them was not only the undescribed flagellate zoöid to be referred to presently, but a large species of Opalina, which I have, after some hesitation, identified with *O. ranarum* Purk. Their appearance and structure are those of the latter, but the size is much less. They are quite active. As they pressed each other beneath the surface or forced each other upward, the aspect of the field of view was comically like a pool of furiously boiling soup with big dumplings bobbing about.

Associated with this crowd was a somewhat more interesting flagellate infusorian. It, in common with most endoparasites, is colorless, and very soft and flexible. Its structure is so different from all other creatures in so many particulars that a new genus is needed to receive it. In its habitat it seems restricted to the rectum. Very seldom, if ever, is it captured wandering into the upper intestine. Its form is more or less ovoid, usually tapering to a somewhat pointed anterior extremity, and its consistency seems scarcely greater than the white of an egg. The three anterior vibratile flagella, about equaling the body in length, are of extreme tenuity, their three-fold aspect appearing only after the most careful scrutiny of the weakened or dying infusorian. In the active animal their rapid motion suggests the existence of

cilia, or, when momentarily seen, they appear as a single filament.

Extending along the entire length of one lateral border is a narrow, rapidly undulating membrane, very readily mistaken for a spirally twisting flagellum. Its free edge seems to be thickened, and its line of insertion on the body has the appearance of a distinct filament or ridge. That this usually conspicuous line is not a flagellum is proved by its invariable adherence to the surface. It has never been observed to lift itself or to exhibit independent movement; it always follows the contortions of the body and always keeps the same relative position in reference to the margin of the undulating membrane. It is, however, very liable to be confounded with a long, thread-like filament which springs from the terminal margin of the membrane. This appendage, unique in its position, seems to have no individual freedom of motion, but follows and completes the undulations of the tissue to which it is attached, as the lash follows the brandished whip-stock. That it has no other connection with the body proper I am convinced, although it is as fine and as difficult to satisfactorily examine as are the three anteriorly inserted flagella.

The parenchyma is usually more or less vacuolar. It becomes conspicuously so when surrounded by water, the vesicles varying in size and often changing their position rapidly. A true pulsating vacuole is absent. The nucleus is also obscure. Occasionally a small refringent disc, usually structureless, rarely granular, is noticeable near the center of one lateral border, and may be the endoplast.

Longitudinally traversing the zoöid from the apex to the posterior extremity, where it conspicuously projects, is a flexible, somewhat curved and rod-like body, enlarged at its origin, thence of a constant width to the distal end where it becomes suddenly acuminate. The point of exit from the sarcode is well marked, the cuticular surface occasionally appearing to surround it for a short distance like a sheath. When the animal is immersed in pure water it becomes shortened and permanently fusiform, and this rod then protrudes an increased length which small protoplasmic drops often cover. What the function and constitution of this motionless and refringent structure may be, it is difficult to conjecture.

No oral aperture is visible. Very rarely a few small dark-

bordered granules are noticeable within the body, but if they are of external origin their mode of entrance is unknown.

Although existing in such profusion I have observed their reproduction in but a single instance. The cause is probably the ease with which they lose their health in water. They are tenacious of life, however, individuals living for twenty-four hours within a rectum in a life-slide, but water does not agree with them. Multiplication took place with amazing rapidity. A drop of sarcode separated from the posterior extremity of the body quickly followed by another, both immediately assuming a spherical form and both almost immediately rupturing and with some force shooting out a zoöid less than one-fourth the parent's size and with the undulating membrane less developed, but otherwise resembling it. Fission, encystment, rupture and escape were all accomplished in less than two seconds. I have witnessed this but once, as stated, yet before seeing it I had repeatedly observed an act whose significance I failed to appreciate until it had been examined in the reflected light of the completed process. It is, that a portion of the posterior extremity of the animalcule frequently becomes separated, but immediately undergoes disintegration or diffluence, and probably represents an attempt at reproduction made incomplete by unpropitious surroundings. The multitudinous young are much smaller than the adults, more spindle-shaped and more active.

Fig. 2 represents the mature endoparasite magnified 1100 diameters.



FIG. 2.—*Exechlyga acuminata*, gen. et sp. nov.

EXECHLYGA (ἐξεχης, *projecting from*; λυγος, *a pliant rod*), gen. nov.—Animalcules free-swimming, soft and flexible, ovate; three long, subequal, vibratile flagella produced from the anterior extremity; an undulating membrane developed along one lateral border; a motionlesss rod-like body traversing the zoöid longitudinally and projecting beyond the posterior extremity; oral aperture none; contractile vesicle absent. Habits, endoparasitic.

Exechlyga acuminata, sp. nov.—Body ovate, widest and rounded posteriorly, tapering to the somewhat pointed anterior apex; length two and one-half to three times the width; parenchyma often vacuolar, colorless; anterior flagella three, as long as the body, subequal and fine; undulating membrane narrow, its margin apparently thickened, the line of insertion usually conspicuous, and its posterior border terminating in a fine filament subequal to the zoöid in length; internal rod-like body curved, anteriorly enlarged, the distal

extremity of the posteriorly projecting portion suddenly acuminate. Length of, body $\frac{1}{1000}$ inch. Habitat, the rectum of the spade-foot hermit toad, *Scaphiopus holbrooki*.

Another infusorian, which lives more or less in the light of the sky, but suffers and often dies when forced to leave its host, occurs not uncommonly as an ectoparasite on the social rotifer Megalotrocha. I have taken it in considerable numbers on colonies obtained from widely separated localities and at long intervals. This season the rotifers have seemed especially abundant and the colonies particularly luxuriant. The infusorian glides rapidly over the surface of the host, often passing from one individual to another, and running to the edge of the ciliary disc, whence a current from a neighboring rotifer occasionally sweeps it into the surrounding water. If carried so far beyond the influence of the currents that it fails to find its way back to the colony, it soon begins to show evidence of uncongenial surroundings. Its form changes, it becomes swollen, pale and ghostly, its cilia act irregularly and the creature speedily dies, the rotifers' cuticular secretions seeming necessary for its welfare.

The ectoparasite referred to belongs to Stein's Hypotricha and to Ehrenberg's genus Chilodon. It differs from the cosmopolitan *Chilodon cucullulus* (Mull.) Ehr., in form and size, in the absence of the sharply pointed anterior extremity or lip, in the greater curvature of the pharynx, in the course of the adoral channel, that of *C. cucullulus* being directed forward and outward from the pharyngeal orifice, and especially in its ectoparasitic habits. The convexity of the dorsal surface varies. In some individuals it is evenly rounded; in others conspicuously flattened and often traversed by irregularly transverse grooves or channels. The curvature of the pharyngeal armature is also variable.

When the parasite is gliding over the host's surface it is not possible to observe the manner of taking food. But individuals having been swept into the water and been brought back by the return current, have occasionally settled on the cover-glass in such a position that the process was apparent. When feeding from the side of a rotifer or from the retracted and rounded extremity, the anterior end becomes much narrowed and elongated, while the pharynx is protruded and closely applied to the surface which it infests.

Reproduction is by both transverse and longitudinal fission. In Fig. 3 is represented the ventral, and in Fig. 4 the lateral aspect magnified about 600 diameters. To designate the species it may appropriately bear the name of the host and be *Chilodon megalotrochæ*.

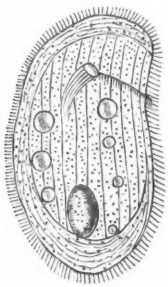


Fig. 3.



Fig. 4.

FIG. 3.—*Chilodon megalotrochæ*, n. sp., ventral aspect. × 600. FIG. 4.—*Chilodon megalotrochæ*, lateral aspect. × 600.

Chilodon megalotrochæ sp. nov.—Body soft, flexible, ovate, the length once to once and one-half the breadth, somewhat widest posteriorly; the anterior and posterior extremities rounded, the left hand border slightly concave near the anterior apex; lip short, obtuse, inconspicuously directed toward the left; dorsal surface convex, naked, the ventral one flat, finely striated and entirely clothed with short, vibratile cilia, those of the anterior extremity somewhat more conspicuous; the adoral groove shallow, directed backward and outward from the pharyngeal orifice, its cilia under insufficient amplification presenting the aspect of a single projecting seta; nucleus ovate, granular, mesially placed in the posterior body-half; pharyngeal armature more or less curved; contractile vesicles numerous, scattered. Length of body $\frac{1}{400}$ to $\frac{1}{350}$ inch. Habitat, ectoparasitic on the social rotifer Megalotrocha.

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GROWTH, ITS CONDITIONS AND VARIATIONS.

BY CHARLES MORRIS.

IN the story of organic life there is nothing more remarkable than the extraordinary diversity in size between mature animals and plants. The question may well be asked why, in one case, an animal is full grown on attaining the size of an ant, while another gains the bulk of an elephant or whale; and why the lowly moss fails to attain the size of its giant brother, the oak. It might be simply answered that this is a mere question of nutrition, some forms being better adapted to obtain food than others. But the question cannot be disposed of so

readily. Other elements than mere nutrition enter into the problem, and its full consideration requires a review of all the conditions of organic life.

As we ascend in the scale of life we find animals to be possessed of constantly more efficient food-taking organs. From the cilia of the Infusoria and the Sponges we pass to the Cœlenterate tentacles and thread cells, the sucking disks of the Cephalopoda, the pincers of the Crustacea, and the limbs and teeth of the Vertebrata, with numberless intermediate implements of capture. There is a like range of efficiency in the weapons of each sub-kingdom and class of animals. An Octopus, for instance, is a thousand fold more efficiently armed than an oyster, and a man than a mouse. There is a like variation in the rapidity of motion of various animals, some being completely sedentary, others exceedingly active. Their mental powers vary in like manner, from utter obtuseness to great quickness of intellect.

All these differences enter into the question of difference of size, yet they only partly suffice to solve the problem. Great diversity occurs between animals of equal organic efficiency, muscular activity and mental quickness. A rat, indeed, is superior in all these requisites to a cow or a hippopotamus, and a mouse is certainly a more highly organized animal than a whale. It has more efficient and better armed limbs, a greater variety of movements and diversity of habits, and probably superior mentality. In this latter respect, however, the ant is in advance of many massive vertebrates, yet it remains one of the smallest of its own class of insects, the largest of which are certainly not the shrewdest.

If we take a close survey of the animal kingdom, one interesting fact quickly appears, namely, that all the animals below man exist but for three purposes, to obtain food, to escape danger and to reproduce their kind. No other marked purpose in their lives can be seen. They rest and sleep to regain strength, they occasionally employ their excess vigor in play, and curiosity and imitation are now and then displayed, but only strongly in the monkey tribe. Yet the great purposes of their lives, and of lower man as well, are the three above named. Only in higher man do the faculties of curiosity and imitation unfold into the desire for knowledge, and the designed effort to attain advanced conditions, which are the basic principles of the higher mental

evolution. Through the persistent exercise of these faculties man, while retaining in strong measure the three life purposes of the lower animals, has added to them many others of a higher grade. But the faculties which have led to man's mental evolution exist only undeveloped or but slightly developed in the lower-life kingdom, and the whole vigor of these lower creatures is given to the purposes named.

These purposes in reality may be reduced to two. Assault and defence are devoted to a single end, the preservation of individual life. Reproductive activity is devoted to another end, the preservation of race life. These two purposes are, to a considerable extent, in opposition. The animal that is efficient in either is apt to be deficient in the other. The one great object to be attained is life continuance. Any animal tribe that declines in both nutritive and reproductive powers dies out. Only those that are successful in one of these powers can hold their own in the life struggle. But it is simply impossible that any tribe can be markedly successful in both these directions, for two reasons. In the first place great reproductive powers interfere with success in food taking, by increasing the number of applicants for the food supply. It sets up a struggle for existence within the ranks of the tribe itself. In the second place there is a physiological opposition, a struggle for existence between the powers of the individual. Great activity in food getting reduces the reproductive energy. Great reproductive vigor exhausts the muscular and nervous strength. Thus no animal can possess superiority in both these directions, and to the extent that it succeeds in one direction, its powers must decline in the other.

This opposition is displayed throughout the whole range of the animal kingdom. As a general rule the smaller and the shorter lived the animal the greater its fecundity. But small size and short life indicate that its powers of obtaining nutriment are limited, or that its destruction by enemies is great. The continued existence of the tribe, in this case, can only be gained by prolific reproduction. Again, some animals have efficient food getting powers while in the larval state, as in the case of certain insect larvæ, while their nutritive advantages are greatly reduced in the mature state. In such cases we find the larvæ to feed and grow rapidly, while the imago scarcely feeds at all, but devotes all its powers to reproduction. But in the case of certain insects which

are well adapted to procure food in the mature stage, as in ants, the reproductive powers fail to develop at all, except in one or a few members of the tribe, while individual life may be continued for years.

The opposition between these two powers is clearly displayed in other cases. Wherever nutriment is abundant and easily obtainable individual life at once gains an advantage over race life. The reproductive period is retarded. But if nutriment become deficient reproduction is hastened. This has been fully proved by experiments on plants, which, if abundantly fed, grow profusely in leaves and branches, but delay flowering. But if subjected to a starvation process they flower early, and remain stunted individually. Instances of the same kind may be observed in animals, and as a rule deficient nutrition may be said to cause reduction of size and early reproductive activity, while abundant nutrition has the opposite effect.

In this regard an interesting conclusion may be drawn from a general survey of the conditions of animal life. Reproduction means the separation from the body of cells which are the epitome in structure of the whole organism. This separation bears a constantly decreasing relation to the bulk of the whole body as we ascend in the animal series. In the Protozoa the germ-cell takes the half of the body, or in some cases the whole of the body is converted into germs. In the Metazoa a lesser portion of the body is shed as germs. The proportion is great in the lower animals, in some cases extreme, but small in the higher classes, and very minute in the highest. The fact that the shedding of germs is hastened by deprivation of food suggests a reason for this difference. Every higher animal is in a certain sense a colony of coherent cell individuals. This coherence is an indication that they are favorably situated for nutrition. If food fails to come to them they will go to seek it. In other words, the offspring of the coherent cells will become wandering cells. This is very probably a constant effect of the growth of animals, since with every increase in bulk the ability to supply the whole mass of cells with food decreases. In consequence we may surmise that wandering cells are budded off by the fixed cells more abundantly as size increases, with the effect of checking the growth of the animal, and eventually of preventing any further increase in bulk.

At the same time the profuse existence of wandering cells is a necessary preliminary condition to reproduction. These cells, as the writer has already advanced in a former treatise,[1] conjoin and subdivide until from the union of cells, each of which possesses the structural peculiarities of only a minor portion of the organism, are produced cells containing the structural characteristics of the whole organism, and consequently suited to become the germs of new organisms.

Such is presumably the general character of animal life operations. The food-getting powers of Protozoa are very slight. Their cilia are inefficient organs, and only suited to the capture of very minute prey. As they increase in size their power of obtaining sufficient nutriment decreases. Hence division takes place and the offspring become wandering cells, since their chances in the life struggle are thus improved. With higher animals special conditions have rendered the colonial aggregation of cells advantageous, and cell-coherence becomes the rule. By combined effort each cell succeeds in obtaining more food than it could have done by its unaided efforts. But in every case as the size of the individual animal increases, its ability to satisfactorily supply all its hungry cells with food diminishes. The point at which the limit in this direction will be reached depends on the degree of efficiency in the food-taking organs, and also on the quantity of available food, more nutriment being requisite the greater the bulk of the animal.

When this limit is reached, individual life growth ceases. The organic powers remain stationary for a time and then deterioration sets in. This deterioration is apparently a necessary result in all organisms, arising from a gradual failure of the individual life powers, or from inimical organic processes which inevitably arise. That this is really the case, however, is not sure. It is by no means certain that an indefinite continuance of individual animal life might not be possible if the reproductive process were completely checked. It might reasonably be conjectured that if this were possible it would have occurred somewhere in the long range of animal development, during which such an extreme diversity of form and condition was produced. But such a race of animals would certainly be at a disadvantage in the life struggle. Its powers of continuous life must gradually succumb to

[1] AMERICAN NATURALIST, June, July, August, 1882.

starvation, accident, the violence of foes and all the external conditions which oppose individual life continuance. Therefore some degree of reproductive activity is necessary to the continued existence of any animal race, and it is probable that any degree of this activity is incompatible with continuous individual life.

The shedding of wandering cells appears to take place throughout the whole life of the higher animals. They may be found as amœboid corpuscles in the blood at all periods of growth. Only in the lowest forms, however, can they be developed as germs of new individuals at all periods. In all forms above the lowest some organ for their temporary reception must be first produced, in which the earlier stages of development can be passed, since the higher the animal the more unsuited is its germ for immediate self-nutrition. When the sexes become separate this grows more necessary, and individual development must pass through certain phases ere the organs necessary for reproduction are unfolded. Over this unfoldment of organs the nutritive conditions exert an important influence. Very active nutrition acts to check structural development. The writer has treated this subject at length in a former paper,[1] and need simply here refer to the case of insects in which structural development is retarded during the active nutrition of the larval stage, and is only actively resumed during the innutrition of the pupa stage. Thus with insects the conditions requisite to reproduction are only completed in the imago stage of development.

It is not alone reproduction that checks growth, since reproduction, under certain conditions, might long continue without that cessation of growth which usually accompanies sexual maturity. But reproduction, to be effective, must be of such a character as to assure the preservation and mature development of at least two offspring to every two parents. This can be done in one of two ways, either by the production of germs in great numbers, if they are left to take their chances of destruction by enemies or hostile natural conditions, or by the production of fewer germs, which are kept under parental protection until the young are able to shift for themselves. Both these processes are exhaustive of vitality. In the case of fish, which shed into the water immense numbers of sperm and germ cells, the physical strength is reduced by great abstraction of vital material. In the

[1] Growth and Development, AMERICAN NATURALIST, July, 1883.

case of land vertebrates, which produce much fewer eggs but furnish these with greater nutriment and give them special care, there is similar exhaustion, as also in the case of mammals, in which a considerable development of the young takes place within the body of the parent. Thus as a rule growth ceases shortly after the period of sexual maturity is reached. The least exhaustive phase of this process is that displayed by the males of mammals, which lose but little vital material and waste little vital strength. They consequently exceed the female in size, yet not inordinately. The conformity in hereditary conditions, and in size of the initial life stage, act to prevent any undue excess in growth of males over females.

The conflict between reproduction and individual energy, however, is but one of the influences affecting the sizes of animals. There are conditions which affect the members of each separate tribe to which we must next advert. Whether two animals shall attain the same size does not depend entirely on whether they are able to obtain the same quantity of food. This is but one element in the problem. Another equally important element is the amount of exertion, physical or mental, necessary to obtain that food. The food is not applied within the body to the single purpose of growth. It is partly consumed in the production of animal heat, partly in recovering from muscular waste, partly in similar nerve recovery, and partly in reproductive activity, while only its excess goes to the formation of permanent new tissue.

As a rule it might be conjectured that cold-blooded animals would exceed the hot-blooded in size. They obtain their heat from without, and use up no nutriment in this purpose. But they are less active and efficient in the pursuit of food, and thus more than lose the advantage which their nutrient superiority might give them. Muscular activity is very exhaustive of nutriment, and we find that the more active animals are usually the smaller. Thus throughout their whole range the Herbivora exceed the Carnivora in size. And of each of these classes the most active species are the smaller. The great Carnivora, the lions and tigers, are only occasionally active. The bears are sluggish in movement. The smaller Carnivora, as the weasel family, are incessantly active. It is the same with the Herbivora. The elephant, rhinoceros and hippopotamus are usually slow moving creatures. The ox family is more active, and the much

chased deer and antelopes are kept in frequent swift motion. In fact the smallest Herbivora are those that trust to flight for safety, the medium sized those that need rapid motion in food getting but are safe from the attacks of Carnivora, or able to defend themselves, while the largest are those which need rapid motion neither for flight nor food getting. The desert-living camel, for instance, must be able to move very rapidly from oasis to oasis. And the horse needs swift motion over the partly barren plains which form its native home. But neither of these has occasion to fly from enemies.

Nervous activity is also repressive of growth, and the larger animals of each tribe are usually the duller mentally. But this is not the case where mental shrewdness replaces activity in the obtaining of food, or where the more intellectual animals possess highly efficient food-taking organs. The cuttle-fish is the largest and probably the most intelligent of mollusks, but its remarkably powerful weapons of assault enable it to obtain much food with little exertion. The same is the case with the elephant, whose trunk gives it special advantages in food getting. In these cases such mental energy as is exercised is correlated with physical sluggishness. In another case, that of the ants, the mental and physical energies are both in high activity, and this is perhaps a main reason why the ants, with plentiful food and no reproductive exhaustion, remain such small members of the insect race.

But a still more important agency in the growth of animals is the efficiency of their weapons of assault and their powers of motion in obtaining them a plentiful supply of food. In all cases the larger animals are those best adapted and situated for obtaining food with the least exercise of muscular and nervous functions. In this latter particular the sedentary animals are at an advantage, but it is far more than counterbalanced by the inefficiency of their means of capture. Unable to go in search of food, they are restricted to such food as they can bring to them by making currents in the water, or which they can capture in passing. To the former purpose the cilia of Protozoa, sponges, the lower mollusks, &c., the winnowing arms of barnacles, &c., are applied; to the latter the tentacles and thread cells of the Cœlenterata. Parasitic animals are also included in this category. None of these animals can grow to a great size, since the quantity of food they can obtain is necessarily very limited.

With respect to active animals their food-taking powers depend on one or more of three requisites, speed of motion, mental quickness and power of weapons. The largest animals among the Carnivora are those which have the highest development of this third requisite, and thus can obtain equal quantities of food with less organic exhaustion. It is not necessary to make a comparison of the weapons of various animals in this connection, as it is evident that there is a steady progression upwards as weapons grow more powerful, from the Protozoan cilia to the Mammalian claws and teeth.

But a highly important influence in this connection is that of special adaptation of animals to particular kinds of food, together with the comparative abundance of this food, and its comparative resistance to capture. The food of carnivorous animals does not tamely submit to destruction. It makes earnest efforts to escape or to defend itself. With animals that depend for safety on flight, and for food on pursuit, the great muscular exertion acts to check growth. Yet if these animals are capable of obtaining plentiful food they may become of considerable size. The weasels and their congeners are adapted to a kind of food which is small in bulk and is only to be obtained by great agility or cunning, often by pursuit through underground burrows. Hence their size is necessarily restricted, since overgrowth would unfit them for their life habits, and thus still further reduce their food supply. Their burrowing prey also are necessarily of small size, from the exigencies of their life habits and the small quantity of food which they are capable of obtaining. On the other hand the much chased deer are grass eaters, and are thus adapted to an abundant food which can be obtained without exertion. They therefore attain a considerable size despite the great muscular exertion which they need for safety. At the same time the larger Carnivora, which feed upon the timid Herbivora, obtain food in large masses, and grow in bulk accordingly, despite their great activity.

With the Herbivora the same rule holds. Their bulk is closely governed by the degree of agility necessary to obtain food, the resistance of this food to capture, its comparative abundance, and the exertion which they need to escape carnivorous foes. The nut-eating rodents, for instance, depend upon food which resists capture, and which can only be obtained in small quantities and

by considerable labor. Thus their food supply is greatly limited. The gnawing teeth of rodents are inefficient weapons as compared with the cutting teeth of Carnivora and the grinding teeth of the large Herbivora. The same remarks might be applied to the food and weapons of the Insectivora. Again, among rodents and in fact among all classes, the tree livers are smaller than the ground livers. They need great agility, their food is usually of reduced quantity, if vegetable food it is usually placed at the extremity of the small branches, if animal it escapes to this extremity, so that great bulk would either reduce the food-getting power, or the safety from danger. The largest arboreal animals are the climbing cats, which obtain their prey by springing, and these are much smaller than the ground-lurking cats. On the contrary the coiling and crushing serpents attain their greatest size in trees, which seem to offer them a special advantage in the capture of large prey.

In regard to those grass and leaf-eating Herbivora which have learned to defend themselves by weapons instead of by flight, and thus to avoid the excessive exertion of their timid relatives, their size is greatly influenced by the degree of exertion necessary to obtain a supply of food; that is, on the abundance of food native to their habitat. The camel, for instance, is native to sandy deserts dotted with occasional grassy oases, so that it needs swift motion and great powers of endurance of hunger and thirst, to enable it to shift from pasture to pasture. The horse also is native to broad, level plains, but sparsely provided with pasturage, and needs swift motion to obtain a sufficient food supply. A similar argument applies to the American bison and the larger deer. These animals, while attaining a considerable bulk, are much smaller than the slugglish tropical Herbivora, the elephant, rhinoceros and hippopotamus, which live among superabundant food, and have little occasion to fear enemies.

Again, as tree-living animals are necessarily small, so are mountain animals of reduced bulk. Though they are in no great danger from carnivorous foes, their food supply is small, and can only be obtained by great exertion. Reference may here also be made to the tribe of birds. These are necessarily smaller than land animals. The element in which they live requires great muscular activity, which increases in a rapid proportion with increase in bulk. Their food supply is also limited, and only to

be obtained by great exertion. But unlike land animals the largest birds are the Carnivora, since the food to which they are adapted is far more abundant than can be obtained by the pecking fruit-eating, or the insectivorous birds. But the largest of all birds are those that have lost the habit of flying, and with it the necessary muscular waste. And of these land birds the largest known to us were those sluggish inhabitants of the Pacific islands, whose habitat was untenanted by large Carnivora, and their food abundant, so that they did not need the activity of the desert-living ostrich.

If now we consider water animals, the considerations here taken receive a remarkable exemplification in the whale, with its bulk so greatly in excess of that of any land animal. An examination of the structure of the great Greenland whale would not lead to this conclusion. It has lost all the weapons on which its land kindred depend. Its teeth have vanished. Its hind limbs have disappeared. Its fore ones are only used for swimming. Its food-getting powers seem singularly reduced, while the food upon which it depends consists of minute, almost microscopic animals. Thus a natural conclusion would be that the whale should be of small bulk instead of gaining such monstrous proportions. But on the other hand its food is superabundant in quantity, and is utterly defenceless against its huge foe. The whale needs no weapons to capture its food. These would be useless and have been lost. All it needs is to rush rapidly through the water with open mouth and swallow the food which it thus collects in great masses. Intelligence would be useless to it, and is greatly lacking. Its muscular waste is comparatively small, since swift motion through the water needs far less exertion than on the land. It has no foes whom it endeavors to escape by flight. Thus there is nothing to hinder its attaining an inordinate bulk. In this whale, and related species of the same general habits, the powers of growth attain their ultimate development.

The same consideration applies to the great sperm whale, which is adapted, indeed, to a food of different character, but seems to obtain as abundant a supply with as little exertion. The remaining water mammals are smaller. They trust to food that is less abundant, and which needs more exertion to obtain. The seals cannot obtain their fish food without great agility, and it is

probable that the huge size of the great sea elephant arises from its being adapted to some less agile and more abundant food than that sought by its smaller kindred. With fish the same rule applies. The powerfully armed sharks far exceed any others in bulk, fish, as a rule, being inefficiently armed and adapted to small sized prey.

If we leave the vertebrates and consider the articulated animals, the same rules hold good. The insects are specially adapted to a restricted food supply, and their weapons are usually such as enable them to obtain food only in small quantities. The sucking, boring and rasping implements with which they work are of no great efficiency, and the largest insects are the strong-flying carnivora with their powerful pincers and jaws. The spiders are equally small, from the minute quantity of food which their cunning brings them. By far the largest articulates are the crustaceans, in whom the pincers have developed into powerful weapons, and who find in their water home larger, more abundant and more easily overcome prey. But in all these cases the size of any particular species is largely the result of the efficiency of its weapons, the size and quantity of the food to which it is specially adapted, and the degree of energy or cunning which it needs to capture its food and to escape its foes.

Thus it would appear that the size of every species of animal has a natural limit, about which it may fluctuate, but from which it cannot widely depart in either direction unless there occurs a marked change in the surrounding conditions or in its organization. Its size depends strictly on the efficiency of its food-taking weapons, the abundance of food to which it is specially adapted, or the mass of food material which it can obtain, the degree of exertion, muscular or nervous, which it needs to obtain this food, the degree of exertion which it needs to escape its foes, and the vigor of its reproductive energy. The latter, however, is a fluctuating element, which acts like the governor of a steam engine. The former conditions control the average size at any fixed period. But if, through a change of conditions, nutrition becomes more abundant, reproduction is correspondingly checked and size increases, while the reverse occurs if nutrition decreases. Thus by a correlation of its two powers of nutrition and reproduction each animal manages to hold its own in the struggle for existence. If, through any causes, an animal tribe falls below the

requisite level in both of these powers, it is in danger of extinction. If it rises above the level some other tribe is in danger of extinction. This latter is a highly important fact, to which further attention will be requisite after some other points have been considered.

We may here speak of the great influence which larval metamorphosis seems to have on the ultimate size of animals. With the invertebrates, as a general rule, the young come into the world half born. They are thrown upon their own resources in a partly developed state, and have a high wall of metamorphosis to climb ere they can reach the stage af maturity. During this larval period they represent animals of a lower grade of organization than the mature form, and more imperfectly adapted to food getting, except in those cases in which the mature form is a degenerated one, or in those other in which the mature form has lost its original adaptation to the food conditions, and thus is forced into immediate reproductive activity, as in the case of many insects. If we take, for instance, the actively feeding caterpillar and compare it with the butterfly, we find the latter, on leaving the pupa case, to be not more than a tenth of the size of its larva, while the new food stock, to which it has become adapted, is much less abundant and easily obtained than that open to the caterpillar. Thus growth force ceases, reproductive activity supervenes, and death of the mature animal quickly follows.

Vertebrates are tided over these larval stages, which they pass either in the egg or in the maternal womb. The loss of life vigor in their case falls upon the mother, not upon the offspring. The marsupials, in which the young are born imperfectly developed, are all comparatively small in size. This may not, however, arise from the cause specified, since the young obtain food from the mother without personal exertion until they have passed through the larval stage. As a rule, as pointed out by Herbert Spencer, the initial size of the animal exerts a vigorous influence upon its ultimate size. If it begins its individual life with large bulk and great food-taking and consuming powers, its growth will be proportionate. He instances the diversity in size of sheep and oxen feeding in the same pastures.

Intelligent selection, as exercised by man upon domestic animals, is capable of producing great variations in size. In the

domestic dog, for instance, a remarkable diversity has been in this way produced. The same effect, though less marked, appears in the other domestic animals. It has become strikingly produced in the horse without design, but merely through diversity in quantity of food, and in the necessary exertion to obtain it in different localities. In these instances we recognize the influence of heredity in preserving variations of chance occurrence. It may be remarked here that man is not the only animal which practices intelligent selection. Bees and ants pursue the same process with their own young, and with remarkable results. Thus with the hive bee a special feeding of one of the worker larvæ yields not only increased size but an important organic development. From being a sterile worker it becomes a functional female, or queen. In the ants the sterile forms often differ widely in size. Dr. McCook measured in one nest nine distinct sizes, the largest being seven times the length of the smallest. Whether this is a result of designed difference of nutrition of the larvæ does not appear, though there are two or three distinct duties in the nest to which ants of distinct sizes apply themselves.

But we have now to consider another phase of the subject which has been of extreme importance in its history. In addition to the influences whose effect upon the sizes of animals we have considered, there is another of equal, if not greater, efficacy. We look upon the tentacle as a weapon of minor power, yet in the cuttle-fish it has become an exceedingly powerful instrument, and through its aid giant animals have been produced. The same may be said of the weapons of the Crustacea, which sufficed, in an early geological period, to yield crustaceans of six feet in length. Even the Medusæ, with their apparently feeble food-taking powers, occasionally attain to great bulk. They are perhaps situated like the whale in the midst of an abundant supply of defenceless food, which can be obtained without special exertion. The defenceless prey of these great sluggish animals are those small creatures which trust to excessive reproductive powers for continuance of their race, and thus have less need of efficient personal defence than with the less prolific.

These cases point to the condition now to be reviewed, that of comparative ability to share in the limited food supply. The struggle for existence is by no means confined to the power of attack and defence, but also takes the form of a struggle to obtain

a full share of the naturally supplied food. This has been one of the most potent agencies in the history of animal development. The living tribes of nature sit down to a bountifully supplied table from which each eagerly seeks to gain a "lion's share" of food. Of those that are adapted to a certain kind of food, on a certain part of the table, the best armed and situated will obtain the most, and increase in size over their less fortunate competitors. On another part of the table animals equally well armed are served with a more meager repast, and thus need greater activity to obtain equal or smaller quantities of food. They consequently decline in size below their better situated relatives. The degree of competition, however, is reduced by the fact that many tribes are adapted to food of quite different kinds from that sought by others. Yet every class of food is eagerly sought for, so that there is everywhere a sharp competition, and the animal so organized and situated as to obtain the most with the least exertion of body or mind, is sure to outgrow all rivals of equal advantages and initial powers of organization. It may be here remarked also that at this great feast of nature the food often resists capture, and is not to be taken without special exertion. Some offers no resistance, some is enclosed in hard or spiny armor, some has active powers of motion and needs to be pursued. Thus the competition is great in degree and in variety, and the sizes attained by the different guests depend greatly on the quantity of food they succeed in obtaining in fixed periods, and the waste of tissue necessary in the struggle.

This competition, while highly influential in keeping existing animals each to its limit of size, was probably, in the geological periods, the most efficient agent in controlling the sizes of animals, far more so than the direct struggle between Carnivora and their prey. A rapid review will show this. In tracing the succession of animals in former ages one fact of importance appears. This is, that the members of the animal kingdom only by slow degrees advanced in the utility of their weapons of attack and defence, in their agility and in their mental ability. In consequence of this successive development the geological periods present us with some highly interesting conditions of animal life, which are of interest in the present connection. Successive waves of life have passed over the earth, each swelling to a cul-

minating point of height and then declining, to be followed by a new wave, and each of superior structure than the preceding. Each wave of life, in fact, has been forced down by the succeeding and superior one, until now the human wave has risen and is forcibly breaking down that which last preceded it.

(To be continued.)

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DR. D. E. SALMON'S CLAIMS RESPECTING THE DISCOVERY OF THE GERM OF SWINE-PLAGUE.

BY H. J. DETMERS.

IN No. 53 of vol. III, of *Science*, pages 155 and fol., appeared an article by Dr. D. E. Salmon, in which he claims priority in the discovery of the cause of swine-plague with reference to my own researches. Since my claims, recently admitted by Pasteur, and in 1880 by the professors of the Royal Veterinary School at Berlin (see page 464 and 465 of the Archiv für wissenschaftliche und práctische Thierheilkunde, vol. VI, part 6), are thus directly disputed, it is incumbent upon me to vindicate them. That Dr. Klein discovered in 1876 microorganisms in the carcasses of hogs that had died of swine-plague, I have nowhere disputed; neither have I expressed any doubt that Dr. Klein may have seen the very micrococci which constitute the cause of the disease. In fact, I have never seen Dr. Klein's report. Only brief extracts of the same have ever come to my knowledge, from which, however, I have not been able to learn that Dr. Klein demonstrated the causal connection of these bacteria with the disease. This proof, absolutely necessary in order to show the parasitic nature of the disease, I was the first to furnish. In special report No. 12, and in the annual report for 1878, of the commissioner of agriculture, can be found a detailed account of my researches. In these I discovered a specific microorganism in the fluids, morbidly affected tissues, and morbid products of the diseased animals, as well when killed by bleeding, as also in the perfectly fresh carcasses of those that had died of the disease. These bacteria were cultivated outside of the animal body, in innocent media, such as milk, mutton broth, and other fluids (see page 37 of the commissioner's special report No. 12, or page 347 of his annual report for 1878).

An inoculation with the bacteria, thus cultivated, reproduced

the disease in due time in healthy pigs (see history of experimental pig C on pages 37, 38 and 39, or pages 347 and 348 of said reports). The quantity of bacteria employed in infecting the sterilized culture-fluids was so small, compared with the bulk of the latter, as to render them harmless by dilution, had the bacteria not multiplied in the flasks. After three days' (from Sept. 23d to Sept. 26th, 1878) cultivation the fluids swarmed with the identical bacteria with which they had been infected, while no others could be found by close and searching microscopical examination. Staining fluids, it is true, were at that time, September, 1878, not employed, but even should these cultures have been contaminated to a minimal extent, the validity of the proof that they reproduced the disease would thereby not be affected. Moreover, I have given abundant proof in my reports that a vegetation of putrefaction bacteria, the very ones most likely to intrude into a culture fluid, destroys, if taking place in the same medium, the pathogenic properties of the swine-plague bacteria, a fact admitted by Dr. Salmon himself in his later reports. As the disease produced by inoculation with an exceedingly small quantity of the cultivated material was typical swine-plague, a more decisive proof of the bacteritic nature of that disease cannot be furnished. Still, although further proof is not really needed, I may yet mention that an inoculation with blood serum from diseased lungs, after it had been freed from the swine-plague bacteria, remained ineffective, notwithstanding that every inoculation with the same material, if not freed from swine-plague bacteria, invariably took effect (see history of experimental pig A, inoculated Oct. 14th, 1878, pages 38 and 39 of special report No. 12, and pages 348 and 349 of the annual report for 1878). But, while I will not relinquish my claim of being the first who has proven the bacteritic nature of swine-plague, I can readily admit any mistake in the description of the bacterium. The insufficient instrument then at my command, a small Hartnack stand, and three Hartnack objectives, a No. 2, a No. 5, and a No. 8, made the coccus-chains appear like moniliform (serrated) rods. Hence my error in naming them bacilli. Although I have since corrected this mistake in the nomenclature in my report of February 28th, 1880 (see page 60 of special report No. 22, or page 412 and fol. of the commissioner's annual report for 1879), frequent repetition of my observations has not forced me to con-

sider anything wrong in my first description beyond the drawings of the bacteria. Better lenses, afterwards employed, easily resolved the apparently moniliform rods into coccus-chains. The same reports of the commissioner, which contain the results of my first researches, also contain Dr. Salmon's first observations on swine-plague, in which he does not make a single reference to bacteria as the cause of the disease.

In the following reports, special report No. 22, and annual report for 1879, I corrected my mistake as to the appearance and the naming of the parasites; while the subsequent report of the commissioner, special report No. 34, or annual report for 1880, which was published a year later, or two years after I had proved swine-plague to be a bacteritic disease, contains the first account of Dr. Salmon's observations in regard to swine-plague bacteria. However ingenious his methods were, however exactly he copied Pasteur's method of experimentation, his results are nowise in advance of mine, published respectively one and two years earlier. I can safely let the reader estimate the value of his and my claims of priority. In my various drawings I have tried to represent what I actually saw in the fluids, morbid tissues, etc., of the animals, and hence have shown different forms of the bacteria, among them Billroth's helobacteria. I have not seen these forms in my cultures, neither have I ever said that the same were proven to be related to the disease, however likely that may be. On pages 61 and 62 of special report No. 22, or the corresponding pages of annual report for 1879, after quoting from Billroth, I remark: "As nearly all these various changes and formations have been repeatedly observed, it *may be* that these club-shaped formations or helobacteria of Billroth, which I was inclined to look upon as foreign to the disease, are only a higher development, or another form of the swine-plague Schizomycetes."

Dr. Salmon's insinuations have no foundation whatever, and his accusations that I have confounded the true parasites (diplococci) of swine-plague with other bacteria cannot be substantiated from my writings.

CHICAGO, ILL., March 20th, 1884.

THE SEGMENTAL SENSE-ORGANS OF THE LEECH.

BY DR. C. O. WHITMAN.

THE only sense-organs hitherto known in the medicinal leech are the five pairs of eyes and the so-called "goblet-shaped" organs located in the edge of the lip (cephalic lobe). A number of writers have noticed and described some small spots occurring on every fifth ring of the body; and one author has suggested that they may have a respiratory function. But no one, so far as the published accounts inform us, has intimated that they represented sense-organs, or suspected that they were the serial homologues of the eyes themselves. These spots, when examined closely with a low magnifying power, will be found to be slight elevations with rounded summits, and for this reason and because they are regularly disposed on the first ring of each segment (somite) they may be called segmental papillæ, a name which does not prejudge the question of their function. In our large pond leech (Macrobdella) these papillæ are comparatively small; and the same may be said of the medicinal leeches of Europe and Japan, and their nearest allies, Hæmopis and Aulostoma. In some of the Asiatic medicinal leeches, for example, those of Saigon, Singapore (*H. maculosa*), Java (*H. javanica*) and Ceylon (*H. multistriata*), they are much larger and have an oval form with a median ridge or crest. In the land leeches they are very conspicuous, having the form of small cones with rounded summits.

In all the ten-eyed leeches of Japan, including both the land and fresh-water forms, twelve of these papillæ are found on the first ring of each complete somite, six on the dorsal and six on the ventral side. In most of the medicinal leeches, however, as well as in Hæmopis, Aulostoma, Macrobdella, &c, there are eight on the dorsal side and six on the ventral.

A careful study of the *arrangement* of these papillæ in a large number of species, and of their histological structure, has brought out in a most conclusive manner their *serial homology with the eyes;* and has led, indirectly, to the recognition of some important points in regard to the metameric composition of the body of the leech. The accompanying diagram will enable me to be brief. The eyes are represented by five pairs of large black dots, the segmental papillæ by smaller dots. The numerals on the

left give the number of somites, those on the right the number of the first ring of each somite. The position of the seventeen pairs of nephridial pores is shown by short dashes (*1st p–17th p*). With the exception of the genital and nephridial pores, the diagram shows only what belongs to the dorsal side. It will be seen that there are twenty-six *transverse* rows of papillæ—one for each somite; and that, owing to their uniform and symmetrical arrangement, they form also eight *longitudinal* rows. We have *two median* rows (*m*) formed of twenty-five successive pairs; *four lateral* rows, an *inner* (*il*) and an *outer* (*ol*) on each side of the median line; and *two marginal* rows (*mg*). The first two eyes hold the position of a pair of median papillæ, while the remaining eyes replace as many *inner lateral* papillæ. About this correspondence in position there is not, in my opinion, any room for doubt. In the diagram the outer lateral and the marginal papillæ are to be seen as far forward as the first eye-bearing ring, the marginal ones alone being absent on this ring; but in most species of Hirudo both of these rows of papillæ are very indistinct or entirely absent on the first three eye-bearing rings. They are present in Aulostoma, and are very distinct in the large medicinal leeches of Saigon, Singapore, Java and Ceylon.

The median rows of papillæ, if their position is not misleading, must be regarded as the metameric equivalents of the *first* pair of eyes; the inner lateral rows hold the same relation to the second, third, fourth and fifth pairs of eyes. There is a possibility that the first pair of eyes are derivatives of the inner lateral papillæ, the median papillæ of this ring having been lost and the eyes brought nearer together so as to stand in line with the median papillæ of the following somites. However, as all the papillæ have the same structure, there is no objection on this score to the opinion that the eyes are derived from both the median and the inner lateral papillæ.

The structure of the papillæ confirms the homology above indicated, if one feature alone be excepted. The eye of the leech, as is well known, is a cylindrical mass of cells, three or four times as long as wide. The central or axial portion is made up of peculiar large glassy cells, in general appearance entirely unlike the other cells of the body. What the peculiarities of these cells are cannot well be explained without illustrative drawings; but for present purposes it will be sufficient to say that each of

these cells has a vacuole-like space occupying a central position which is probably filled with some kind of fluid. Whatever this fluid may be, it is not colored by any of the dyes in common use. The protoplasm of these cells forms a thick peripheral envelope with a rounded thickening on one side which projects into the vacuolar space. The very small nucleus is usually located near the base of this internal protuberance. This axial portion consisting of clear cells is enveloped by a thick layer of pigment on all sides except the external end. The epidermal cap covering these cells is convex, and entirely free from pigment, forming thus a window-like opening into the black pigment-cup which holds the large transparent cells. An optic nerve enters the eye near its deeper end, and runs along the axis for a larger portion of its length. It is probable that branches of the nerve connect with the clear cells, but precisely how has not been ascertained.

In sections of the segmental papillæ we find all the elements of the eye except the pigment. There is a branch of the lateral nerves that runs to each; and from four to six or more of those peculiar large glassy cells are found a little below the epidermal cap, which is convex and free from pigment.

The absence of a pigment-cup holding the glassy cells makes it doubtful whether the papillæ can be regarded as light-perceiving organs, but it does not, to my mind, weaken the evidence of their serial homology with the eyes. It is generally found that the posterior eyes, especially the fifth pair, are smaller than those preceding them; and I have noticed cases in which only a mere trace of pigment could be seen in one or both of the last pair of eyes. While it appears doubtful what the function of the papillæ is; still, the presence of large cells precisely like those in the eye, situated just below a window-like opening in the surface pigment, and their obvious serial equivalence with the eyes, makes it not improbable that they represent incipient organs of vision.

Although the evidence appears to me conclusive that the eyes and the segmental papillæ were, originally, morphological as well as physiological equivalents, it does not of course follow necessarily that both now have the same functional significance. The original papillæ may have represented sense organs of a more or less indifferent order, among which, in the course of the historical development of the leech, a division of labor was introduced, a few at the anterior extremity becoming specialized as organs of

vision, the rest either remaining in their early indifferent condition, or becoming specialized in some other direction.

In order to get a clearer and fuller idea of the fact that the eyes are metameric organs representing merely structurally improved forms of the segmental papillæ, let us look more closely at the rings and the somites composing the body. As a glance at the diagram will show, there are in all 102 rings between the first pair of eyes and the posterior sucker; the last two or three are more or less imperfect. The papillate rings show us precisely how many somites there are. Of the *twenty-six* somites, *sixteen* (7-22 inclusive) have each five rings, while the remaining ten have from one to three rings. Of these abbreviated somites *six* form the anterior and *four* the posterior end. We notice that the abbreviation is greatest at the extreme ends, from which it is plain that it began at these points and progressed towards the center of the body. The first two somites have each a single ring, the third is represented by two rings, and the fourth, fifth and sixth each by three rings. The first six somites then include only thirteen rings, less than half the number contained in six complete somites, such as are seen in the middle region of the body. The twenty-third somite embraces three rings, and the twenty-fourth, twenty-fifth and twenty-sixth each two rings. The last four somites contain only nine rings. The abbreviation not only extends to a larger number of somites at the anterior end than at the posterior, but it has been carried farther in the individual somites, at least in the first and second. At both ends the papillate rings have been preserved, while the less important non-papillate rings have been in part or wholly suppressed. The suppression of rings takes place by consolidation, two successive rings gradually coalescing. The papillate ring may coalesce either with the preceding or the following ring. In the medicinal leech the fifth ring, bearing the fourth pair of eyes, is now in process of uniting with the sixth; while the eighth is absorbing the seventh. The evidence that these two rings are being swallowed up is seen first of all in the rings themselves, and secondly, in the different conditions which they exhibit in different species and genera. In Hirudo and several allied genera the sixth and seventh rings are comparatively narrow, and the grooves separating them from the fifth and eighth rings are entirely obliterated on the ventral side, so that here the four rings appear as two. On

the dorsal side they are still distinct, but not so deeply marked off from the fifth and eighth rings as from each other. The same process of consolidation is seen in Hæmopis, Aulostoma and Hæmadipsa, but in different stages. In Macrobdella all four rings are distinct on both sides, but the consolidation has already begun, as the grooves separating the fifth from the sixth, and the seventh from the eighth, are not so deep as the groove between the sixth and seventh, or that between any two of the succeeding rings.

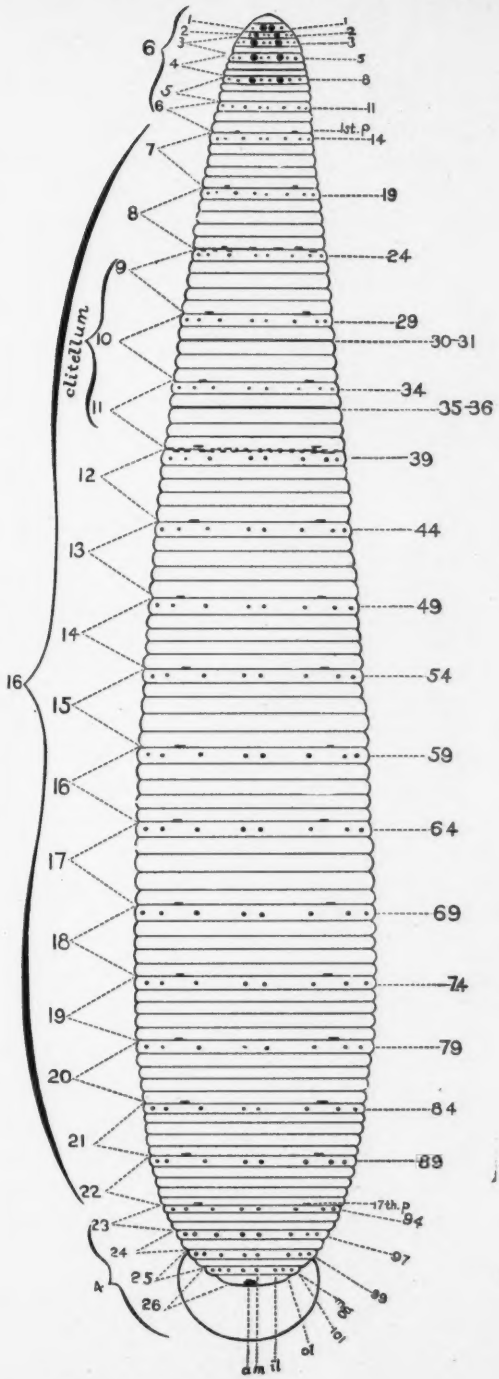
If the abbreviation is centripetal, we should expect the fourth ring to disappear before the sixth and seventh. This course of events has already been completed in the land leeches, in none of which is there a ring intervening between the third and fourth pairs of eyes.

Two non-papillate rings may also unite with each other; an instance is seen in the twenty-third somite of Macrobdella, where the second and third rings are well nigh consolidated.

The syncopation of rings has been carried farther in the acetabulum than in either of the posterior somites. In some species the segmental papillæ are quite distinct on the disk, and in these their arrangement shows that papillate rings alone have been preserved in this region.

The sacrifice of rings has been greatest in those parts that have been compelled to do the most work, namely, the two extremities. In the anterior somite the papillate rings have been preserved and functionally improved in proportion to the number of the less important non-papillate rings eliminated. In the posterior disk the loss of rings is not correlated with an improvement of the sense-organs, but with an increased development of muscles. The habits of the land leech have favored the development of a still greater muscular power in the disk, and this has been attended with a loss of five rings, leaving only four rings in its four terminal somites to offset nine rings on the aquatic leech.

If the historical development of the leech has been a progressive course of abbreviation such as we have described, it is evident that an ancestral form must have existed in which the somites were more nearly alike from end to end. The embryonic development confirms this view, for in its earlier phases the somites form a chain of very nearly equal parts. It is somewhat later that a few (7–8) of the posterior somites become constricted off and



Segmental Sense-Organs of the Leech.

consolidated into the sucking disk. The somites at the anterior end are the first to arise and hence the first to exhibit specialization.

Among existing species three in Japan have departed less from the hypothetical ancestral form than has Hirudo. They agree with the medicinal leech in having twenty-six somites, but differ from it in having eighteen instead of sixteen complete somites. In one of these species there are plain evidences that abbreviation has already begun in one of the eighteen somites.

The segmental papillæ then enable us to give a tolerably complete analysis of the body, to read some chapters in its past history, to predict some portions of its future, and to draw a few safe conclusions respecting the phylogenetic relationship of different species and genera. The discovery that these papillæ are sense-organs might lead us to speculate on affinities of a more distant and uncertain nature; such as are supposed by the writer, in common with many others, to exist between annelid worms and vertebrates. At all events the existence of such organs in the leech furnishes a broader basis for the discussion of the question whether the vertebrates and annelids have been derived from a common form possessing metameric sense-organs.[1]

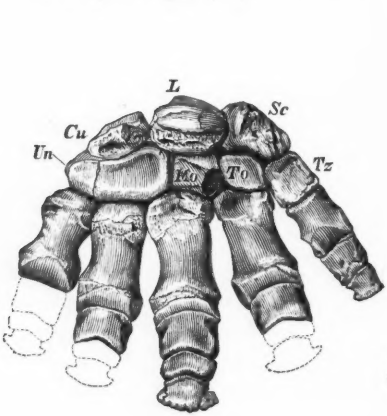
Assuming that the sense-organs of the lateral line of the vertebrate and the segmental papillæ of the leech may be traced to a common origin in some remote ancestral form, it does not follow that they should now present close structural resemblances. It is far more important to show that they possess certain general features in common. The most important of their common features is undoubtedly their metameric origin. The nerve-supply forms another feature of fundamental importance, in which according to the interesting observations of Mr. Beard on "the segmental sense organs of the lateral line" (*Zool. Anz.*, VII, Nos. 161, 162) of the vertebrate, there is essential agreement. The developmental history of these lateral organs in the fish, where they make their first appearance as *segmental papillæ* in the strictest sense of these words, cannot at present be explained on a more satisfactory hypothesis.

[1] Dr. Eisig of the Naples Station is the original expounder of this view.

THE AMBLYPODA.

BY E. D. COPE.

THE Amblypoda is that order of hoofed mammals in which the internal bones of the carpus are in linear series, the magnum supporting a part of the lunar only, and not reaching the scaphoid; and in which the tarsal bones are interlocked, as in the later types of hoofed Mammalia; that is, the cuboid bone articulates extensively with the astragalus, as well as with the calcaneum (see Figs. 1–2).



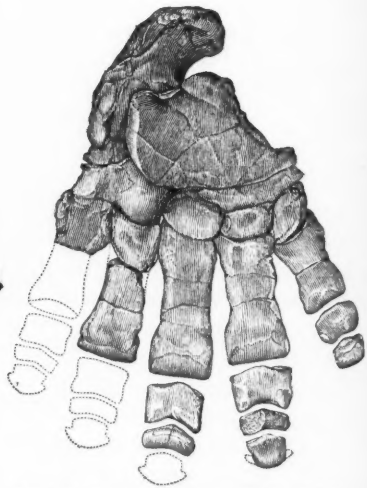


FIG. 1.—Right manus of Coryphodon. Original, from Proc. Amer. Philos. Society, 1882, p. 441. *Sc*, scaphoid; *L*, lunar; *Cu*, cuneiform (imperfect); *Tz*, trapezium; *To*, trapezoides; *Mo*, magnum (face broken); *Un*, unciform. From a New Mexican specimen. See Report U. S. G. G. Survey W. of 100th mer., IV, pl. LXI.

FIG. 2.—Right posterior foot of a species of Coryphodon from New Mexico, one-half nat. size. From Report Expl. W. of 100th mer., G. M. Wheeler, IV, pl. LIX.

Various other characters are associated with these, some of which may be coëxtensive with them, and therefore to be regarded as characters of the order. Thus all the known species have five toes on all the feet, and a flat astragalus without trace of groove. The unciform bone is extensively in contact with the lunar, as in the Diplarthra. The hemispheres of the brain are of singularly small size, and are separated from the olfactory lobes and from the cerebellum by their crura. The feet are always short and plantigrade.

Ordinal characters of wider significance are seen in the pres-

ence of a postglenoid process; the presence of enamel on the teeth, and the absence of any teeth growing from persistent pulps. The superior molar teeth are constructed on the tritubercular type.

Mammalia presenting the above combination of characters first appear in the Puerco Eocene epoch, and continue through the Wasatch and Bridger epochs, and then disappear. They have not been found in later deposits. The Puerco species are smallest in dimensions, while those of the Bridger epoch are the largest of Eocene Mammalia, equaling in the size of some of their bones the largest of living terrestrial Mammalia. Besides their great size the species of the Bridger epoch prove the ancient exuberance of their growth-energy in the development of extraordinary processes and horns on the head and large and formidable canine teeth.

Three suborders represent this order. Each one is confined to a distinct horizon of the Eocene period, with one doubtful exception. The characters are as follows:

Astragalus with a head; a third trochanter of femur; superior incisors.. *Taligrada.*
No head of astragalus; a third trochanter; superior incisors..... *Pantodonta.*
No head of astragalus, nor third trochanter, nor superior incisors..... *Dinocerata.*

The Taligrada only occur in the Puerco epoch, the Pantodonta are confined to the Wasatch, and the Dinocerata belong to the Bridger epoch, one species having been found extending downwards into the Wasatch, unless there be some error.[1]

The Taligrada.

The Taligrada are represented by one family, and one genus, Pantolambda Cope.[2] This form is interesting on various accounts. It furnishes the only known example of a tritubercular selenodont superior molar dentition. That is, each of the three cusps of which the crown of the superior molar is composed, is a well-formed V (Fig. 3 *a*). We shall see later on, that this form explains the origin of the peculiar molars of some of the Pantodonta. Its astragalus is of remarkable form, which is intermediate between that presented by the other members of the order, and the diplarthrous ungulates, as for instance, the rhinoceroses (Fig. 3, fig. *d d' d''*). It has the flat tibial face characteristic of all the Puerco mammals, and of many of those of the Wasatch

[1] This is the *Bathyopsis fissidens* Cope.

[2] See NATURALIST, 1883, p. 406.

epoch. The inferior molars are much like those of Coryphodon, but differ in certain details. The premolars are even more like those of that genus (Fig. 6). The humerus differs from that of all other members of the order in having an epicondylar foramen (Fig. 5 *a*). In this respect, and in its large internal epicondyle, the form is like that of some Creodonta. The ilium differs remarkably from that of the other genera of the order in its narrow form, with flattened

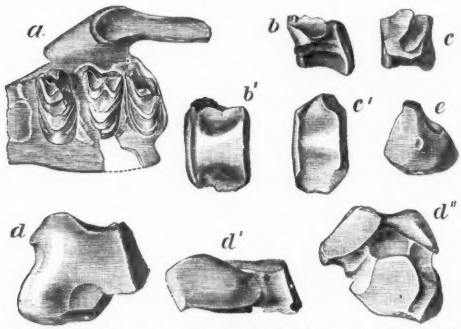


FIG. 3.—Bones and teeth of *Pantolambda bathmodon* Cope, two-thirds nat. size. From the Puerco beds of New Mexico. Fig. *a*, part of maxillary and malar bones from below, showing true molars, all somewhat broken. Figs. *b* and *c*, cervical vertebræ, left side; *b'* and *c'*, do. from below. Fig. *d*, astragalus from above; *d'*, from front, showing facet for cuboid; *d''*, from below; *e*, navicular bone from below. Original, from Report U. S. Geol. Survey Terrs., F. V. Hayden.

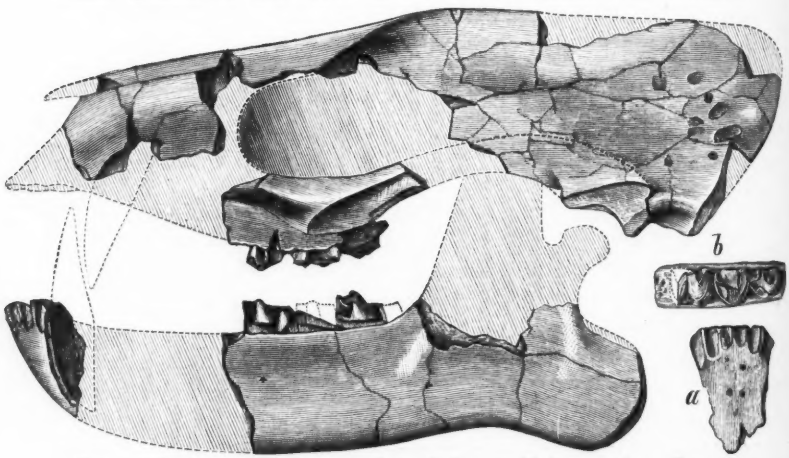


FIG. 4.—*Pantolambda bathmodon* Cope, skull, two-thirds nat. size. From the Puerco beds of New Mexico; individual represented in figs. 3 and 5. Fig. *a*, symphysis mandibuli from front. Fig. *b*, last two premolars and first true molar of inferior series from above, of a second individual. Original, from Vol. III Report U. S. Geol. Survey of Terrs., F. V. Hayden in charge.

triangular section, as is seen in various Rodentia. It approximates the Condylarthra in this respect also.

In all respects Pantolambda presents primitive characters. The V shape of its molar tubercles only presents us with the highest known modification of the primitive tritubercular molar,[1] excepting those which succeeded it in time in the remaining suborders of the Amblypoda.

Of the genus Pantolambda two species have been discovered, both by Mr. David Baldwin, in New Mexico. The smaller of these, the *P. bathmodon* Cope (Fig. 4) is about the size of a coyote, the larger, *P. cavirictus* Cope (Fig. 6) is as large as a South American tapir, or nearly equal to the smallest species of Coryphodon. The ungues of the *P. bathmodon* which have been found (Fig. 5 *c*) are narrower than those of the *P. cavirictus*, but they may differ in proportions on different digits as in the species of Phenacodus. Both species are furnished with formidable canine teeth, but they are of normal form, and do not present any of the peculiarities of those of the Pantodonta or Dinocerata. In the lower jaw of the *P. cavirictus* (Fig. 6) they are somewhat recurved, furnishing a formidable seizing and holding weapon. The lower edge of the mandibular

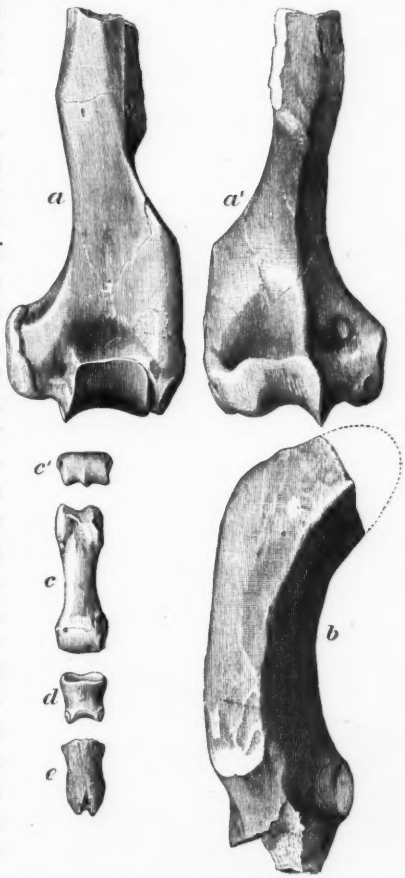


FIG. 5.—*Pantolambda bathmodon* Cope, bones of individual represented in figs. 3 and 4, two-thirds nat. size. Fig. *a*, distal half of humerus, posterior side; *a'*, anterior side. Fig. *b*, ilium from inner side. Fig. *c*, metapodial bone from front; *c'*, distal view; *d*, phalange; *e*, unguis. Original.

[1] On this subject see Proceeds. Amer. Philos. Soc., 1883, p. 324.

ramus is prominent anteriorly, leaving a concavity of the lateral face posterior to the root of the canine. This resembles a good deal what is seen in the cat-like genus Nimravus and allies, which

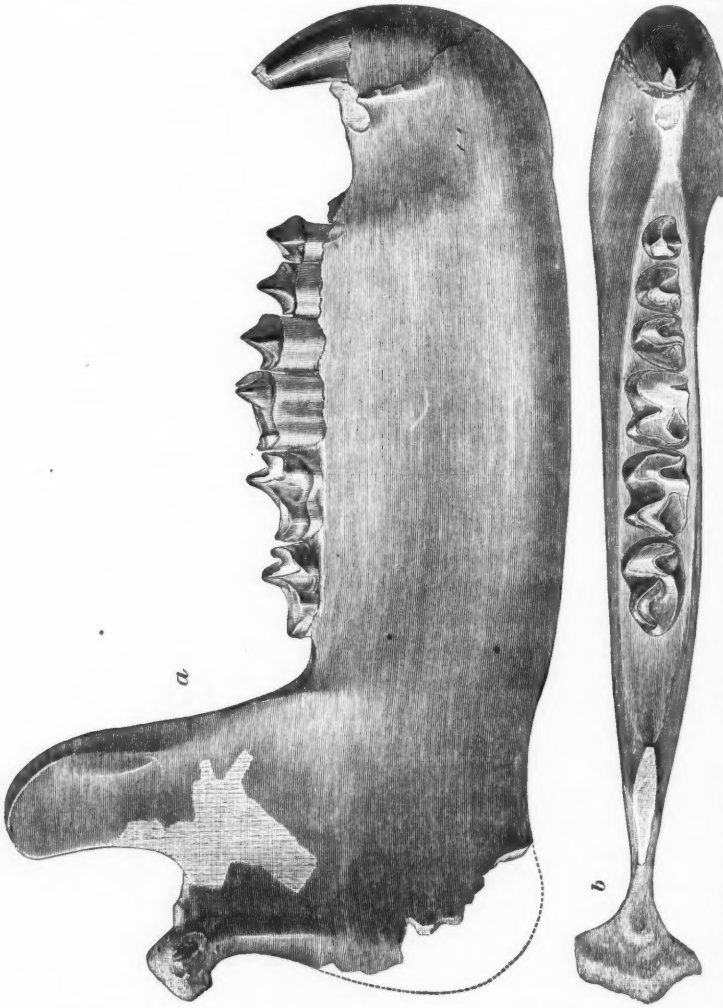


FIG. 6.—*Pantolambda cavirictus* Cope, mandibular rami, two thirds natural size. Fig. *a*, right ramus for outer side. Fig. *b*, left ramus from above. From Puerco bed. Original, from Vol. III Report U. S. Geol. Survey Terrs., F. V. Hayden in charge.

are probably the ancestors of the saber-tooth tigers. The corresponding form in Pantolambda in the same way foreshadows the great development of mandibular flange, and of the superior canine, seen in the Dinoceratous group of this order.

The homologies of the parts of the teeth of the different genera of the Amblypoda are not determined without considerable study. The greatest difficulties are presented by the superior molars, and in order to understand them it is necessary to study the inferior molars first.

If we compare the inferior molars of the *Pantolambda cavirictus* with those of the *Bathyopsis fissidens* (Fig. 7) (one of the Dinocerata) the following modifications will be observed: (1) The two limbs of the anterior V in the true molar of the former are represented in the latter by a single crest with two appressed apices at the inner extremity. These apices represent those of the two limbs of the V. (2) The posterior limb of the posterior V is much diminished in elevation, and does not join its anterior limb at the apex on the external side of the crown. If we now examine the corresponding parts of another Dinoceratous Amblypod, a species referred by Mr. Osborn to the genus Loxolophodon (Fig. 8), we find the process carried still further. The crown has only two crests which approach each other but do not join at the apex on the inner side. The

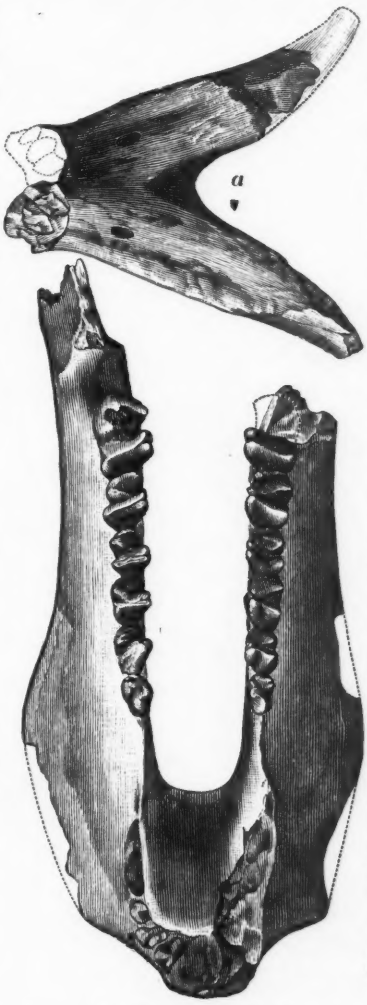


FIG. 7.—*Bathyopsis fissidens* Cope (one of the Dinocerata), mandible anterior to the coronoid process; incisors and canines and first premolar lost from both sides, two-thirds nat. size, from above; *a*, from front. Original, from Wind River (? Bridger) of Wyoming. From Vol. III Report U. S. Geol. Survey Terrs., F. V. Hayden.

FIG. 6.—*Pantolambda cavirictus* Cope, mandibular rami, two thirds natural size. Fig. *a*, right ramus for outer side. Fig. *b*, left ramus from above. From Puerco bed. Original, from Vol. III Report U. S. Geol. Survey Terrs., F. V. Hayden in charge.

posterior limb of the posterior V has disappeared, and a small

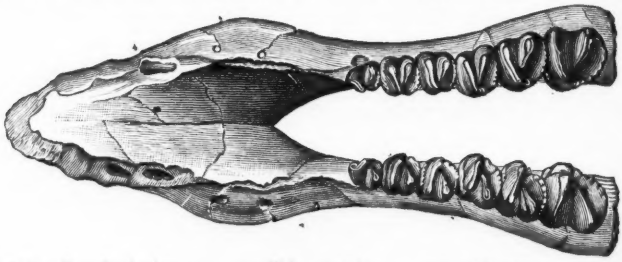


FIG. 8.—Loxolophodon sp., mandible anterior to coronoid process, one-fourth nat. size; from Bridger beds of Wyoming. From Osborn, memoir on Loxolophodon and Uintatherium.

cusp represents the posterior crest of the anterior V.

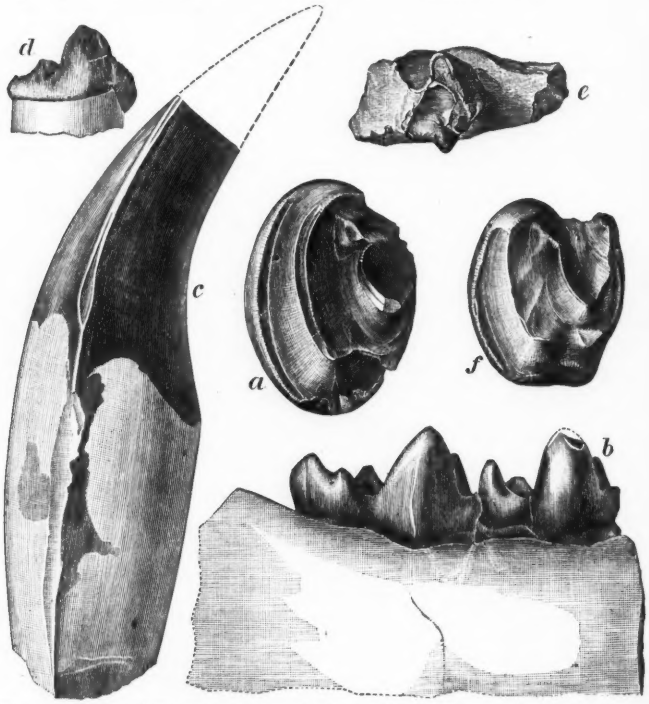


FIG. 9.—Teeth of Pantodonta, two-thirds nat. size. Figs. *a–d, Coryphodon anax* Cope; from the Wasatch beds of Wyoming. Original, from Vol. III Report U. S. Geol. Surv. Terrs. Fig. *e, Coryphodon cuspidatus* Cope, last inferior molar from above, anterior V broken; from New Mexico. Report U. S. G. G. Survey W. of 100th mer., G. M. Wheeler, original. Fig. *f*, last superior molar of *Manteodon quadratus* Cope, from below; from Wyoming. Original, from Vol. III Report U. S. Geol. Surv. Terrs., F. V. Hayden in charge.

Let us now compare the superior molars of Pantolambda (Fig. 3) with those of Coryphodon (Fig. 9 *a*). The two external Vs of the former are represented in the latter by a cusp and a partial V, which form an oblique ridge on the external half of the posterior side of the tooth. This arrangement is already imitated on the last molar of Pantolambda, where one of the Vs has disappeared, and the one that remains is very oblique.

The second V preserves its form better in the superior molar of *Manteodon quadratus* (Fig. 9 *f*); while in the genus Metalophodon Cope, it is reduced to a cusp, forming the inner extremity of a transverse crest. (A figure of this genus will be given in the next number of the NATURALIST.) The interior V of Pantolambda is represented by a corresponding angle at the inner side of the crown in Coryphodon (Fig. 9 *a*), and the two ridges which connect it with the external base of the crown are well marked. Besides these there is developed on the anterior side of the base a strong cingulum. This is wanting on the posterior side, but is present in a feeble form in Pantolambda (Fig. 3). I have sometimes called these the superior and inferior anterior cingula respectively. In Coryphodon the posterior superior cingulum is unsymmetrically bulged near its interior end, and in Manteodon it develops a cusp at this point, the crown thus becoming quadritubercular (Fig. 9 *f*).



FIG. 10.—Dinocerata teeth, one-fourth nat. size. Upper figures superior molars of *Uintatherium leidianum*, one-fourth nat. size. Lower figure, inferior molars of jaw of Loxolophodon represented in fig. 8. From Osborn, memoir on Uintatherium and Loxolophodon.

If we now compare these teeth with those of Uintatherium (Fig. 10) we have little difficulty in determining the presence of the two anterior cingula. The difficulty is to ascertain the homology of the posterior transverse crest. It is difficult to see in it the two external Vs of Pantolambda confluent into a simple ridge, yet such it seems to be. This will be especially clear on comparison with the figure of Metalophodon. One is tempted to compare it with the posterier superior cingulum of Coryphodon, but the frequent presence

of a cusp posterior to its internal extremity in the Dinocerata presents a further obstacle to such a determination. This cusp is probably homologous with the posterior internal tubercle of Man-

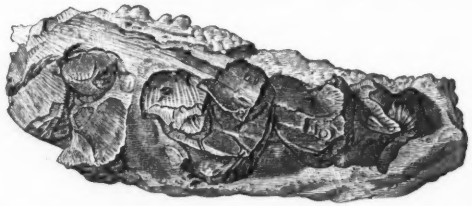


FIG 11.—Last three temporary molars, and first true molar partly protruded, of a Coryphodon from New Mexico, nat. size. Original, from Report U. S. G. G. Survey W. of 100th mer., G. M. Wheeler, Vol. IV, pt. II.

teodon (Fig. 9 *f*), and is, therefore, the posterior internal of the quadrituberculate molar type. The internal extremity of the posterior crest of the crown in the Dinocerata cannot, therefore, be that cusp, and that ridge is not a posterior transverse crest, such as is present in most Perissodactyla.

It is interesting to observe that the fourth superior deciduous molar in Coryphodon (Fig. 11) has essentially the same structure as the true permanent molar of Pantolambda (Fig. 3).

The origin of the Amblypoda has not yet been traced. What was known on this point, as well as on the question of the descendants of the order, was stated as follows in my paper on the classification of the ungulate Mammalia, published in 1882:[1]

"As regards the inner part of the manus, I know of no genus which presents a type of carpus intermediate between that of the Taxeopoda and Amblypoda on the one hand, and the Perissodactyla and Artiodactyla on the other. Such will, however, probably be discovered. But the earliest Perissodactyla, as for instance Hyracotherium, Hyrachyus and Triplopus, possess the carpus of the later forms, Rhinoceros and Tapirus. The order Amblypoda occupies an interesting position between the two groups, for while it has the carpus of the primitive type, it has the tarsus of the later orders. The bones of the tarsus alternate, thus showing a decided advance on the Taxeopoda. This order is then less primitive than the latter, although in the form of its astragalus it no doubt retains some primitive peculiarities which none of the

[1]Palæontological Bulletin No. 35. Proceedings Amer. Philosoph. Society, 1882, p. 445.

known Taxeopoda possess. I refer to the absence of trochlea, a character which will yet be discovered in the Taxeopoda, I have no doubt.

"The Taxeopoda approach remarkably near the Bunotheria, and the unguiculate and ungulate orders are brought into the closest approximation in these representatives. In fact I know of nothing to distinguish the Condylarthra from the Mesodonta, but the ungulate and unguiculate characters of the two divisions. In the Creodonta this distinction is reduced to very small proportions, since the claws of Mesonyx are almost hoofs. Some of the genera of the Periptychidæ present resemblances to the Creodonta in their dentition also.

"The facts already adduced throw much light on the genealogy of the Ungulate Mammalia. The entire series has not yet been discovered, but we can with great probability supply the missing links. In 1874 I pointed[1] out the existence of a yet undiscovered type of Ungulata, which was ancestral to the Amblypoda, Proboscidea, Perissodactyla and Artiodactyla, indicating it by a star only in a genealogical table. This form was discovered in 1881, seven years later, in the Condylarthra. It was not until later[2] that I assumed that the Diplarthra are descendants of the Amblypoda, although not of either of the known orders, but of a theoretical division with bunodont teeth.[3] That such a group has existed is rendered extremely probable in view of the existence of the bunodont Proboscidea and Condylartha. That the Taxeopoda was the ancestor of this hypothetical group, as well as of the Proboscidea, is extremely probable. But here again neither of the suborders of this group represent exactly the ancestors of the known Amblypoda, which have an especially primitive form of the astragalus not found in the former. In the absence of an ankle joint the Amblypoda are more primitive than any other division of the Ungulata, and their ancestors are not likely to have been more specialized than they. It is probable that a third suborder of Taxeopoda has existed which had no trochlea of the astragalus, which I call provisionally by the name of Platyarthra.

"The preceding paragraphs were written in May, 1882. On

[1] Homologies and Origin of Teeth, etc., Journal Academy Nat. Science, Philada., 1874, p. 20.

[2] Report U. S. Geol. Survey W. of 100th mer., p. 582, 1877.

[3] This hypothetical suborder has been called Amblypoda Hyodonta.

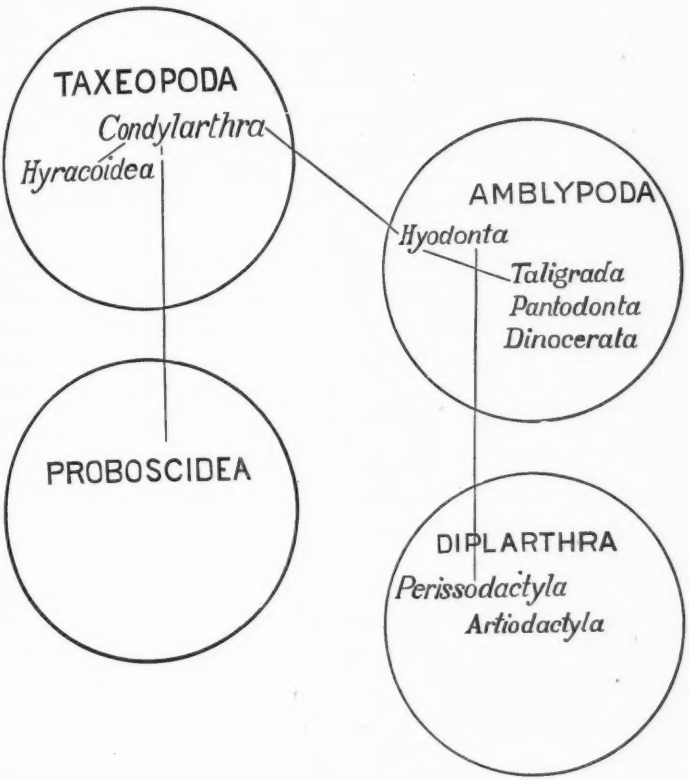
my return home, September 1st, after an absence of three months, I find that various parts of the skeleton of Periptychus have reached my museum.[1] On examination I find that the astragalus of that genus fulfills the anticipation above expressed. *It is without trochlea*, and nearly resembles that of Elephas. As it agrees nearly with that of Phenacodus in other respects, I only separate it as a family from the Phenacodontidæ. One other type remains to be discovered which shall connect the Periptychidæ and the hypothetical Hyodonta, and that is a taxeopod without a head to the astragalus—unless, indeed, the 'Hyodonta' should prove to have such a head. I think the latter the less probable hypothesis, and hence retain the term Platyarthra for the hypothetical taxeopod without trochlea or head of the astragalus." This group as at first defined had been already discovered, but in the above paragraph I added another definition, endeavoring to preserve an apparently useless name.

The existence of Amblypoda Hyodonta is rendered almost certain by the discovery that the genus Pantolestes of the Wasatch epoch is an artiodactyle with tritubercular bunodont superior molars. The ancestral type of such a form must have been a tritubercular bunodont amblypod. Pantolambda is such a form with the tubercles modified into Vs. Moreover, such a type (Amblypoda Hyodonta) would be derived from a periptychid Taxeopod with but little modification of the latter. A distinct facetting of the astragalus for the cuboid bone, and *probably* a change of the carpus by an articulation of the unciform and lunar bones, would be all that would be necessary. The discovery of Pantolambda has increased the probability of such change having taken place in the hind foot, since *the astragalus is intermediate in form between those of Coryphodon and Periptychus.* This is particularly seen in the form of the head, which is not separated by a neck as in Periptychus, but is more prominent than in other Amblypoda (Fig. 3). Thus it is possible that Amblypoda Hyodonta will be found to have a short head of the astragalus, contrary to my supposition above expressed. The headless astragulas of other Amblypoda and of Proboscidea is perhaps a derivative and not a primitive character.

The following diagram gives expression to these views as to the phylogeny of the ungulates. It is the same that I published

[1] See NATURALIST for August, 1884, for figures.

in 1882 in the paper above quoted, modified so as to be more intelligible:



(*To be continued.*)

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— The American Association for the Advancement of Science met this year in Philadelphia, between September 4th and 11th, inclusive. Omitting Saturday, which was given up to excursions, and Sunday, there were six and a-half days of work. The first of these was devoted to the addresses of welcome, and those of the vice-presidents, or chairmen of the sections. The

members in attendance were more numerous than at any previous meeting, rising to about 1300. Of these about 300 were members of the British Association, which adjourned at Montreal a day before the American Association convened. About 300 papers were read, and their average of excellence was comparatively high. Some of the best were read by our foreign guests. A few excellent papers were read by ladies, notably in the chemical, biological and anthropological sections. The address of the retiring president, Professor C. A. Young, treated of the great problems of celestial physics, and will prove both informing and stimulating to a wide circle of readers. The arrangements made by the local committee were admirable. The only drawback to the complete success of the meeting was the sickness of the distinguished president, Professor Lesley, which prevented him from taking part in many of the meetings. The postponement of the Congress of Geologists which was to have been held this year in Berlin, prevented immediate action on the question of an international scientific association. The committee having the subject in charge was continued and enlarged. Committees on the investigation of parasitic plant diseases, on the nomenclature of the brain, on methods of presenting statistics, and on ferments, were appointed. Propositions to meet, at some future time, in Toronto, Canada, and London, England, were brought forward for future consideration. The convention adjourned to meet next year at Bar Harbor, Me., or at Ann Arbor, Mich., as an alternative. In spite of the high temperature which prevailed, being much of the time above 90° F., the meeting was an enjoyable one, and the citizens of Philadelphia will reap some permanent benefit from its occurrence among them.

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RECENT LITERATURE.

FORBES' SECOND REPORT OF THE NOXIOUS INSECTS OF ILLINOIS.[1] —This excellent report is like Mr. Forbes' first one, replete in original matter with full references to the work of his predecessors, so far as it is useful to his readers, and with good illustrations, some of them borrowed, while the table of contents and index are full and detailed. The arrangement and style are plain, simple and to the point. The report is mainly devoted to an

[1] *Thirteenth Report of the State Entomologist on the noxious and beneficial Insects of the State of Illinois.* Second annual report of S. A. FORBES, for the year 1883. Springfield, Ill., April, 1884. 8vo, pp. 205, XXIII, 15 plates.

account of all insects known to be in any way destructive to the strawberry, but also contains accounts of the wheat-bulb worm, the wheat straw worm, notes on insects affecting sorghum and broom-corn. The black-headed grass maggot, a species of Sciara, is also described, the fly not having been bred. The report closes with notes on the black fruit weevil, on the green apple-leaf hopper and the lesser apple-leaf folder. The life-histories of the following insects are new to science: *Meromyza americana, Cacœcia obsoletana, Lygus lineolaris, Deræocoris rapidus, Scelodonta pubescens.* The new species described are *Cœlinius meromyzæ, Chaitophorus flavus* and *Siphonophora minor.*

The field work, the laboratory researches and the practical hints in this report offer little subject of criticism. It is to be hoped that a long series of such reports will be issued by the State, as those which have thus far appeared are in every way creditable to the State and its entomologist, and we know they are duly appreciated by the entomological and horticultural public.

CATALOGUE OF AQUATIC MAMMALS OF THE UNITED STATES.[1] By F. W. True.—This paper includes a catalogue of the species of Cetacea, Sirenia and Pinnipedia of the coasts of North America, with notes and some observations on their distribution and habits. It will be found useful to mammalogists and other students of the subject. American cetology has lagged behind other departments for two reasons. It was first undertaken by the reviewer, who went to much expense and labor in collecting skeletons of whales and other forms. These were unfortunately presented to the Philadelphia Academy of Natural Sciences, and the department falling into incompetent hands, the material became practically inaccessible, so that the project of working up the subject had to be abandoned. The writer has long felt that he owed this explanation to the cultivators of the subject, in order to account for the very imperfect condition in which he left the literature, and also for the fact that some of the material is not now to be found. The second cause of the delay has been the ill health of Professor J. A. Allen, of Cambridge, who took up the subject next. We hope that Mr. Allen will be able to resume the pen which he laid down too soon for the good of American science.

A few points in Dr. True's catalogue admit of criticism. In referring to the type specimen of the *Megaptera osphyia* Cope, he says that in mounting the specimen all the vertebræ, except the atlas, have been reversed. He then adds, "I am convinced, from careful measurements, that the great height of the dorsal and lumbar neural spines, on which the species is mainly based, is a misapprehension," etc. The following quotation from my

[1] From the report of the United States exhibit in the International Fisheries Exhibition of London in 1883. Washington, 1884.

description of the species, shows that Dr. True is guilty of an inaccuracy as to the grounds on which the species was distinguished: "The shorter head and fins, the peculiarly high neural spines and peculiarities of the cervical vertebræ, would seem to distinguish this [species] from the *longimana*." I add that since my description was written, the museum at Niagara Falls, where the specimen is preserved, has been rebuilt, and the skeleton very probably remounted by an inexperienced person.

Dr. True and others are correct in the supposition that my *Hyperoödon semijunctus* is a Ziphius, as I have known for a long time, and had supposed I had published. The *Agaphelus gibbosus* must be withdrawn from the list of authentic species. The bones which I referred to it are probably those of *Balænoptera rostrata*. The characters of the animal in the flesh were given me by persons whom I supposed to be trustworthy, but who may have been mistaken. The species may, however, be the *Balæna gibbosa* of the old authors. Dr. True is not always consistent in his nomenclature. Thus he adopts the name *Phocæna brachycium*, the first name of the species which was published with a description. The species had previously been named *P. americana* without description. The history of the name *Balæna cisarctica* is the same. It was first described under this name, though it had probably already received the catalogue name *B. biscayensis*, without description. Dr. True adopts the latter name. The name *B. cisarctica* should, by the rules of nomenclature, be allowed to stand, and is also much the better one. It has been adopted by American authorities, as Gill, Allen, Holder, etc.—*E. D. Cope.*

WINCHELL'S REPORT ON THE GEOLOGY OF MINNESOTA.[1]—The more notable features of this annual report are Steng and Kloos' paper on the crystalline rocks of Minnesota, which is dated Giessen and Hanover, August, 1876. Besides presenting notes of rock outcrops in Central Minnesota, Mr. Warren Upham reports on the glacial lake, Agassiz, the area and depth of which are thus described, its old beaches being well described and indicated on a map: "When this glacial lake attained its greatest extent, just before it found an outlet into Hudson bay, over the melting ice-sheet, its length from south to north was probably greater than Lake Superior; but its area was only half or two-thirds that of Lake Superior because of its less average width. At the time of the formation of its highest beach, the depth of Lake Agassiz above the Lake of the Woods was some 200 feet; above the Red River valley, at our northern boundary, 450; and above Lake Winnipeg about 600 feet."

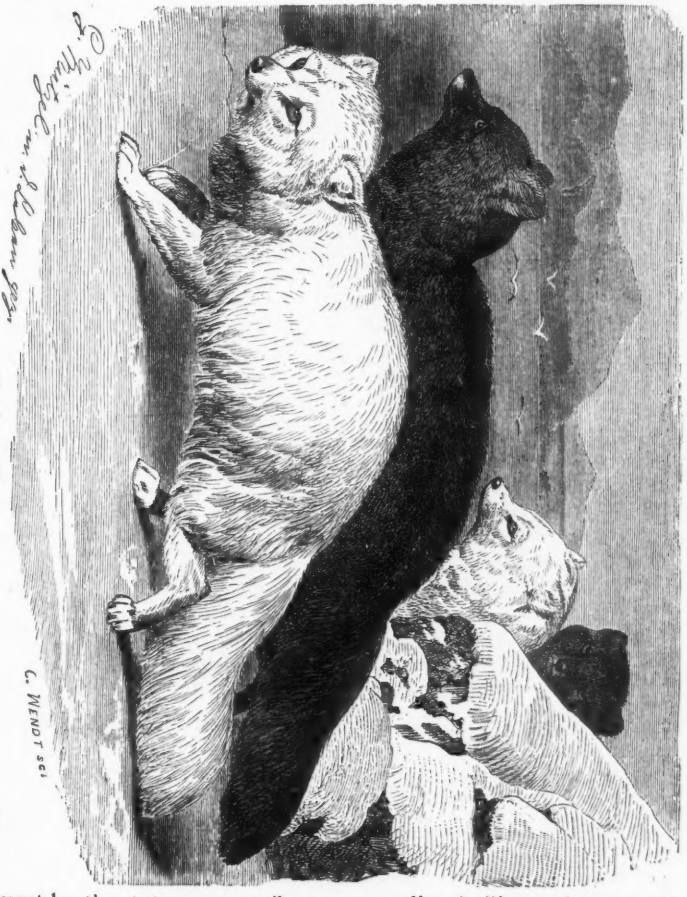
Mr. Upham does not accept Gen. Warren's view that the drainage of this region was directed southward by an elevation of the land considerably above its present height north-east of Lake

[1] *The Geological and Natural History Survey of Minnesota.* The eleventh annual report for the year 1882. N. H. WINCHELL, State geologist. Minneapolis, 1884. 8vo, pp. 219, with two maps.

Winnipeg, but "that the surface of the continent had nearly the same form then as now, and that the continental ice-sheet, resting on the land in a solid mass of great depth, formed the northern shores of Lake Agassiz and was the barrier that prevented its flowing into Hudson bay."

On p. 138 is not Mr. Upham a little sweeping? Has transported drift been found on Mt. Katahdin above a point 3500 feet above the sea, and was the summit of Mt. Washington glaciated? The occurrence of the single boulder found by Professor Hitchcock scarcely proves so much as that.

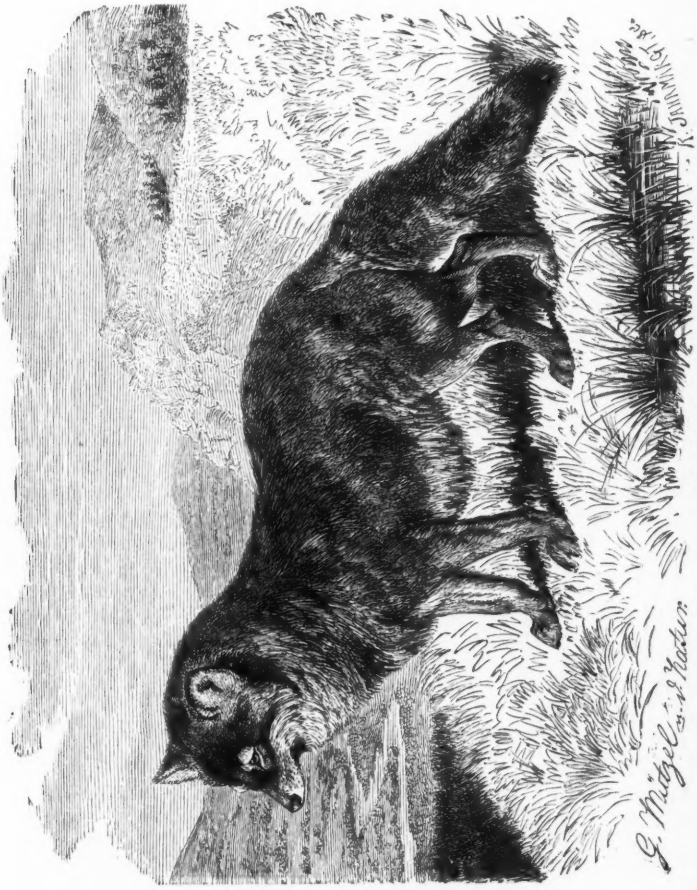
THE STANDARD NATURAL HISTORY.—This work is being rapidly completed and appears to be well sustained in point of treat-



The Arctic Fox.

ment by the different contributors, as well as in illustrations, paper

and presswork. The seventeenth number finishes the chapter on Carnivora. The portion relating to the Arctoidea has been prepared by Rev. Samuel Lockwood, the other groups by Mr. W. N. Lockington; though these writers are not specialists in mam-



The Coyote.

malogy they appear to have been accurate in their statements of facts.

The accompanying figures of the arctic fox and the coyote, which are, like most of the other illustrations, taken from Brehm, will give a fair idea of the nature and value of the illustrations in parts 14–17.

GEOLOGICAL SURVEY OF ALABAMA.[1]—The first quarter of this volume of more than six hundred pages is devoted to a tolerably full consideration of the soil in its chemical and geological relations, and its relations to vegetable and animal life, with an account of the various manures and of their suitableness and action upon different kinds of soil. The second and larger part treats of the main agricultural features of the State, including an outline of its physical geography and geology. The Coosa and Tennessee valleys, coal measures district, oak and pine uplands and other regions of the State are described in detail, a list of the characteristic plants of each region is given, and the work concludes with descriptions of the agricultural resources of the counties, and cultural and economic details of cotton production. An agricultural map and maps showing the rainfall, temperature, area planted in cotton, etc., add greatly to the usefulness of the work.

RECENT BOOKS AND PAMPHLETS.

Linnæan Soc. of New York.—Transactions of the Linnæan Society of New York. Vols. I and II, 1883-'4. From the society.

Collett, J.—Geology and Natural History of Indiana. 13th report, 1883. Part I. Geology and Natural History; Part II. Palæontology. From the State geologist.

Lacy, W. M.—An examination of the philosophy of the unknowable, as expounded by Herbert Spencer. 1883. From the author.

Beecher, C. E.—Ceratiocaridæ from the Chemung and Waverly groups at Warren, Pennsylvania. Harrisburg, 1884. From the author.

Thominot, A.—Sur un Mabuya d'espèce nouvelle, also Note sur un poisson de les famille des Cyprinodontidæ. Ext. du Bulletin de la Soc. Philomathique de Paris, Mars, 1881. From the author.

Lydekker, R.—Mem. Geol. Surv. India. Palæontologia Indica, Ser. X, Vol. III. Part. 3. Rodents and new ruminants from the Siwaliks, and Synopsis of Mammalia. Calcutta, 1884. From the author.

Hasse, C., Kliver, M., Schlosser, M., Schenk, A.— Palæontographica. Beiträge zur Naturgeschichte der Vorzeit, Part CXXXVI. Cassel, 1884. From M. Schlosser

Schlosser, M.—Die Nager de europäischen Tertiärs nebst Betrachungen über die Organisation und die geschichtliche Entwicklung der Nager überhaupt. Cassel, 1884. From the author.

Guldberg, G. A.—Sur l'existence d'une quatrième espèce du genre Balænoptera dans les mers septentrionalis de l'Europe. Ext. du Bulletin Acad. Roy. de Belg. 3me serie, tome VII, 1884.

——Sur la présence, aux temps anciens et modernes de la baleine de Biscaye (on Nordcaper) sur les côtes de Norwège. Ext. idem. Both from the author.

Wadsworth, M. E.—Methods of instruction in Mineralogy. Abs. of paper read before Soc. Nat. E. U. S., Dec. 27, 1883, also letter to Science, Aug. 8, 1884.

——Notes on the rocks and ore-deposits in the vicinity of Notre Dame bay, Newfoundland. Ext. Am. Jour. of Science, Vol. XXVIII, Aug., 1884.

——The fortieth parallel rocks. Ext. Proc. Bost. Soc. Nat. Hist., Vol. XXII, Oct., 1883.

——On the evidence that the Earth's interior is solid. Ext. Amer. Nat., June, 1884. All from the author.

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[1] *Geological Survey of Alabama.* Report for the years 1881 and 1882. By EUGENE ALLEN SMITH, Ph.D., State geologist. 1883.

Albrecht, P.—Sur les spondylocentres épipituitaires du crane, la non-existence de la poche de Rathke, et la presence de la chorde dorsale et de spondylocentres dans la cartilage de la cloison du nez de vertebrés. Bruxelles, 1884.

——Sur le valeur morphologique de la trompe d'Eustache et les derives de l'arc mandibulaire et de l'arc hyoidien. Both from the author.

Jordan, D. S., and Swain, J.—Descriptions of Scaroid fishes from Havana and Key West, including five new species. Ext. Proc. U. S. Nat. Mus. From the authors.

Putnam, F. W.—Remarks on the antiquity of Man in America. Rep. Proc. Amer Ant. Soc., April 30, 1884. From the author.

Lawrence, G. N.—Characters of a new species of Pigeon of the genus Engyptila from the Island of Grenada, W. I. From the Auk, Vol. 1, No. 2, April, 1884.

——Descriptions of new species of birds of the genera Chrysotis, Formicivora and Spermophila. Both from the author.

Milne-Edwards, A.—L'Expedition du Talisman faite dans l'Ocean Atlantique. Ext. du Bull. hebdom. de l'Assoc. Sci. de France, Dec., 1883. From the author.

Ryder, J. A.—On the preservation of embryonic materials and small organisms, with hints on mounting and imbedding sections. 1884. From the author.

Allen, H.—Allen's Human Anatomy. Section VI. Organs of sense, organs of digestion and genito urinary organs. Phila., 1884. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

ASIA.—*Recent Travels in Arabia.*—No more adventurous journey has been undertaken for many years than that of Mr. C. M. Doughty through the heart of Arabia, among wild Bedouins who had never previously been visited by an *Engleysy* and *Nasarang* an Englishman and a Christian, as our traveler freely avowed himself to be. Although this honest avowal caused Mr. Doughty to be in peril of his life on more than one occasion, yet he made friends among the nomads, and claims that his bold course has been the means of making the name of Christian respectable, instead of abhorred, in the vast stretch of country traversed by him.

In the early part of 1875 Mr. Doughty was at Petra, the remains of which he believes to be those of a few public halls or temples, and of sepulchres, while the city itself, probably built of clay, has disappeared. He was asked by the villagers whether he had seen the similar remains at Medyin Salih, ten journeys distant by the Haj or pilgrimage road from Maan, a station near Petra. He at once formed the resolution to visit these ruins, and in the autumn of 1876 accompanied the Haj to the spot. Medyin Salih is a level plain, sixteen miles long and as many broad, surrounded by sandstone precipices, and the ruins lie about a mile from the garrisoned station. The name signifies cities of Salih, who, according to Arab tradition, was a prophet who preached to the unbelieving people of Hel-Hejr until a judgment fell on them.

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

Hejr, or Hejra, was an emporium on the old gold and frankincense road of the Sabaeans. The houses, probably of clay, have vanished, and their site is marked only by bits of broken glass and pottery; but the sepulchral chambers, hewn out in the soft sandstone cliffs, still remain. The façades, full of cornices and pilasters, show a strange mingling of Egyptian and Greek. On the top of each is the stepped ornament so common at Petra. The pediments usually have at their sides urn-like ornaments, others have griffin-like figures. In some cases the tympanum has a man's head with the braided side-locks now called "horns" by the Arabians. In a gorge near by is a hall (the only excavated chamber not a sepulchre) with a number of engraved tablets. The inscriptions are in a Nabathean-like character.

Eleven miles further south, near the village of el-Ally, was the site of another old town. Here were a number of other inscriptions, not Nabathean but Himyaric in character. Baith Naam is the name handed down by tradition, and Mr. Doughty suggests that it may be the Badanatha of Pliny.

The "Harra" of Arabia is the "butte" of our own arid regions, a platform of sandstone preserved from erosion by a capping of basaltic lava. In one of these to the north of Medyin Salih the lava attains a depth of more than a hundred fathoms. The platform is studded with craters at the summits of cones rising from 200 to 600 or 700 feet. The highest, Jebel Anaz, rises 1000 feet or more.

Teyma is a village on the site of an ancient city of the same name. The houses are gone, but the old city wall, three miles around, still stands, together with the remains of some columns. Inscriptions were found here in a character which Sir H. Rawlinson thought to be allied to the Phœnician. The next spot examined after a vist to Hayil was Khaybar, which was reached by traversing another Harra known as the Harrat Khaybar. Near the middle of this region the altitude is nearly 6000 feet, and this Harra is the water-parting between east and west in Northern Arabia, the waters running eastwards in the great trough known as Wady-e'-Rumma, and westwards into the Wady-el-Humth. The former has long been known, but Mr. Doughty found its head near the villages of Hayat and Howeyat, while its mouth is at Sheyor, near Bosra, so that if it were a stream instead of a dry trough, it would be an affluent of the Euphrates. The Wady-el-Humth was previously unknown to geographers. Its head is in the steppes beside Tayif, and its mouth on the Red sea, between el-Wejh and el-Haura. Boreyda and Aneysa, the two largest towns in Nejd, have a population respectively of 5000 and 7000.

On his way from Aneysa to Jidda, in company with a caravan laden with *samma* or clarified butter, Mr. Doughty saw, on an elevated steppe on a basis of granite, the best natural pasture he

had seen in Arabia. The presence of the pastures is due to annual tropical rains, which fall for five or six weeks together, commencing at the end of August or the beginning of September. This region is occupied by the great Bedouin nation, Ateyba. In the last days of the journey the caravan passed alongside of the great southern Harras, where the lava had been poured out upon granite.

Arabia is a land of sepulchres and ruins. The modern Arab neither bores deep wells and builds stone houses, as did the ancient Arabians, nor even builds of clay and constructs dams, as in a more recent age. Among the most ancient remains are huge erect stones such as in England would be called Druidical, and buildings of huge Cyclopean blocks. The façades at el-Hejr are thought by Mr. Doughty to date from the earlier centuries of the Christian era. Barrows of prehistoric or uncertain age are numerous. Mr. Doughty has made drawings of three renowned idol-stones of the ancient Arabians. He also discovered an antelope which is new to science, and lives in the sandy deserts of Sherrarat, Kahtan and Muna.

The geology of Arabia is simple. A central cone of Plutonic rocks is overlaid by sandstones, and these again by limestones, sometimes with flints. The latter rocks, which appear again between the Dead sea and Jerusalem, are, Mr. Doughty believes, of nearly the same age as the chalk, while the underlying sandstones represent the greensand.

Mr. Doughty's journey was concluded in the autumn of 1878, although his account of his adventures is comparatively recent. A year ago the celebrated orientalist, Professor Julius Euting, traversed much of the same ground, discovered a large Aramaic column at Teyma, and obtained numerous inscriptions at Medyin Salih and El Ally; but a report spread among the Bedouins that his box of copies of inscriptions contained pure gold, and he with difficulty saved his life. He previously discovered a hitherto unknown Jewish temple at Palmyra.

Sir Charles W. Wilson's Notes in Anatolia.—Anatolia, or Central Asia Minor, is a plateau which rises gradually from 2500 feet in the west to some 4500 in the east, near the foot of the Anti-Taurus. The Taurus range, which in some places rises little higher than the plateau, but in others, as in the mountains of Lycia and the Bülghar Dagh, attains 7000 to 8000 feet, buttresses the table-land on the south; on the west the edge of the plateau is broken by numerous broad valleys, without any very great elevation; on the north-west rises the high range of the Mysian Olympus; on the north stretches a range of varying altitude without a distinctive name; and on the east the Anti-Taurus supports a higher plateau that extends eastward to Erzerüm. Here and there minor ranges, as the Phrygian mountains and the Sultan

Dagh, rise above the general level, and there are some remarkable mountains of volcanic origin, among which Mount Argaeus, near Kaiserieh, is the loftiest and best known (13,000 feet).

The streams of the central and southern part of the plateau are lost in salt lakes, or supply fresh-water lakes, the waters of which find their way beneath the Taurus and reappear as noble streams running to the south coast. Thus the waters of Eregli lake reappear as the sources of the Cydnus, whilst those of the large lakes, Beyshehr and Egirdir, swell the volume of the Melas and the Eurymedon. Many hot springs occur, marked often by the ruins of Roman baths, and still used by the Anatolians.

The climate is much like that of New England, cold in winter, hot in summer. On the south coast the winter is delightful. As three sides of the country are surrounded by water, there are three summer sea-breezes, from the north, west and south. These opposing breezes produce a calm belt of intense heat in the center. In winter intensely cold northern winds with torrents of rain and heavy falls of snow prevail. At the break-up of the winter a dry south wind rapidly thaws the snow, and by the evaporation produces a feeling of intense cold. Forests flourish most in the north, but the entire country has tracts which are nowhere surpassed for agricultural and fruit growing purposes. The enormous mineral wealth of the country, gold, silver, lead, iron, chrome, rock-salt, kaolin, etc., is as yet undeveloped.

It is usually supposed that Anatolia is the home of the Turks, but it seems as though whenever the modern so-called Turk is examined, he is found to be the descendant of the native races of the country, and to differ from the Christians of the region only in religion. In Anatolia the Galatian and Cappaduan are still well-marked. Since the Greek war of independence there has been a great movement of Greeks to the western sea coast, resulting in the almost entire displacement of the Moslem population. The so-called Greeks of the interior are, however, of Pontic or Cappadocian origin. There are a few villages of true Turks in the Angora and Brusa districts; they occur also in the towns, and form most of the official class. Around the head of the Gulf of Scanderûn is a knot of mountains in the valleys between which flow the Cydnus (Teraus Chai), Sarus (Sihûn) and Pyramus (Jihûn). The Cydnus is formed by the junction of three streams which rise in deep gorges at the foot of the Taurus, here called the Bûlghar Dagh. The Sihûn is formed by the junction of the Samanti and Saris, the former of which runs to the west of the Anti-Taurus, while the latter pursues its course along the rich open valley which divides the twin ranges of the Anti-Taurus. The Jihûn, formed by the union of several streams, breaks through the Taurus by a deep gorge, and then, after traversing some open country, bends to the west, passes through a narrow defile between the Giaour Dagh and the Taurus, and enters the

Cilician plain, where it is joined by several important tributaries. The Giaour Dagh runs from the Taurus south-west to the Mediterranean south of the Gulf of Scanderûn. The great Cilician plains is thus enclosed by the Taurus and Giaour Dagh. The plain of Issus is parted off from it to the east by the hills of Jebel Nur east of the lower course of the Jihûn. The Cilician plain consists of a rich stoneless loam brought down by the rivers, but the plain of Issus is stony and uncultivated. The Giaour Dagh, the Ansariyeh mountains, Lebanon, and the hills of Western Palestine form one side of the great hollow in which lie the valleys of the Orontes, Leontes, and Jordan, with their continuations to the Red sea. The eastern wall of this depression is formed by the Kûrt-Dagh and the Anti-Lebanon. When the accounts of the movements of Darius and Alexander are compared with the topography of the plain of Issus, accessible only by three "gates," and narrow at its southern portion, it is probable that the Pinarus (on which Darius' army was encamped) is the stream which enters the sea south of Piyus.

GEOGRAPHICAL NOTES.—M. Aumoitte gives, in L'Exploration, a record of his journey from Hanoi through Bac-Ninh to Lang-Son, on the Chinese frontier. At the meeting of the provinces of Bac-Ninh and Lang-Son the country becomes mountainous, the roads are bad and the brigands have almost depopulated the district.——The first mail of the season from Kadiak brings the news that the eruption on Augustine island, Cook's inlet, was much exaggerated. The island was not split in two, nor was a new island formed, but the west side of the summit has fallen in, forming a new crater, and the entire island has risen so much that the only bay or boat harbor is filled up. The winter was mild, the lowest temperature was 10 F., and wild flowers were in bloom at the end of April.——Mr. Jos. Thomson reports that the region traversed by him from Mombasa to the north of Victoria Nyanza is entirely volcanic. One volcano, west of Kilimanjaro, shows signs of activity. Mount Kenia, though covered with trees, stands in a desert. The customs, dwellings, religion and language of the Masai, as well as their features, differ markedly from those of other African peoples known to Mr. Thomson.—— The Bolletino of the Italian Geographical Society gives the regulations and programme of the first Italian Geographical Congress, which meets at Turin from Aug. 15 to 19. Among the subjects for discussion are, "What ethnological conclusions are to be drawn from recent anthropological and philological data regarding the indigenous populations of East Africa?" "What are the best means of organizing an independent Hatian Expedition to the Antarctic seas?" "On the need of preparatory schools for training travelers," and "On the importance of establishing commercial stations in the Barbary States as a means of gaining

access to the Sudan."——Mr. Holt Hallett and his party have reached Bangkok after an arduous journey of five months from Montmein. The work done comprises the surveying of over 1500 miles, the determination of the position of the Shan mountain ranges and a large series of observations of the vocabularies of the aboriginal races and the histories of the several Shan States. The expedition was everywhere well received, and has collected much information upon the interior of Indo-China.——The river Chandless, a tributary of the Purus, named after Mr. Chandless, who ascended the Purus in 1864 to a distance of 1866 miles from its mouth, was ascended last year by the Brazilian steamer *Santurem.* It flows from or through a large lake.——Mr. H. O. Forbes is making arrangements to visit Southeastern New Guinea.——Further notes of the travels of M. Giraud states that Lake Bangweolo proved to be only an immense morass. The Luapula flows out of the south side of the lake, and describes a long curve to the south and west for 100 miles before taking its definite northerly course. At the bend he was stopped by a great cataract, named Mombuttuta, and by hostile natives who made his party prisoners and seized his boat. After two months he escaped and joined his caravan, which he had sent on to Cazembe, but here again he was plundered of his stores and most of his carbines. After narrowly escaping death by hunger, he reached the station of the London Missionary Society, at Lake Tanganyika, and was aided to cross to Karema. He describes Lake Maero as a large and beautiful lake, with high banks. He will resume his journey as soon as his stores are replenished.—— After the departure of Lieut. Wissmann, the late Dr. Pogge returned to Tushilange Land, where he remained until November 9th, 1883, when, as no news reached him, and his means were nearly exhausted, he decided to return to the west coast. From a letter which he wrote at Malange, February 2d, 1884, it appears that before crossing the Kassai, he made a detour northward, and found that the Lulua joins that river five days march north of Mofuka. He then proceeded parallel to the Kassai as far as Kikassa, where he crossed the river, going south-westward across the Loange, Quilu, and Ohamba. He had scarcely reached St. Paul de Loanda when he was attacked by inflammation of the lungs, and died March, 10th, 1884.——The Danish government has sent Lieut. Jansen and Herr Lorenzen to explore the outskirting land of Greenland, between Holsteinburg and Sukkertoppen, a part as yet unvisited by Europeans. An expedition to the east coast of Greenland will be undertaken by Lieut. Holm.—— The country of the Phou'ons, situated between Tongking and Laos, on the upper waters of the Song-Cà and Song-Pho, tributaries of the Gulf of Tonking, and on the upper parts of the Nam-Sam and Nam-Muon, affluents of the Mekong, has during the last ten years suffered much from the invasions of the Hôs or

Chinese, who are driven onwards by the misery and excess of population that exists in the southern provinces of China.—— Sir Buonfanti, in his recent expedition across North Africa, was compelled to desist from his attempt to penetrate the unexplored region south of Adamawa, and finally, making his way to the Niger at Say, midway between Timbuktu and the Binue confluence, ascended the river to the former place. As this feat, before believed impossible, was performed in the dry season, the fact has considerable commercial importance. From Timbuktu the explorer passed through Massina and Bambarra to the almost unknown territory of Tombo, where the expedition was plundered and dispersed. After great sufferings, Sir Buonfanti reached a Catholic mission in the Bussanga country north of Dahomey.—— In the western part of the Straits of Magellan glaciers exist on the slopes of a range of mountains the highest peaks of which are not above 4500 feet. The winds from the Pacific, eternally blowing from the west, and full of moisture, keep up a constant condensation, and the glaciers exist wherever the broken ground allows them a foot hold. The largest observed by Mr. W. J. L. Wharton was the Northbrook glacier, with an area of from fifty to seventy square miles.——The Russian government has under consideration a plan for an expedition to the North Pole. Depots will be established at the Jeannette, Bennett and Henriette islands. From these islands the journey will be continued to Franz-Josef Land by steamer, and thence on sledges and on foot.

GEOLOGY AND PALÆONTOLOGY.

Blanford on Homotaxis of Geologic Periods.—In his address before the British Association for the Advancement of Science at Montreal, Mr. W. T. Blanford devoted considerable attention to some remarkable exceptions to the rule that similarity of faunas and floras in fossiliferous formations throughout the surface of the world implies identity of geological age.

Some interesting contributions have been made to this question by the geological survey of India, where Mr. Blanford's experience has been chiefly derived, and by the geologists of Australia and South Africa; and he first noticed a few typical instances, several of them Indian, in which the system of determining the age of various formations by the fauna or flora has led to contradictory results, and then showed where the source of error appears to lie. The famous Pikermi beds of Greece, a few miles east of Athens, contain a vertebrate fauna nearly always quoted as Miocene; but they overlie strata with well-proved Pliocene marine Mollusca. The Siwalik beds that flank the Himalaya north of Delhi are still classed as Miocene by most European writers, but are regarded as Pliocene by the Indian survey, on evidence found by tracing them west and south into Sind. The

Gondwána system of Central India, a great sequence of fresh-water beds probably of fluviatile origin, over 20,000 feet thick, is of unusual interest on account of the extraordinary conflict of palæontological evidence it presents.

Its subdivisions are numerous, and vary in almost every place of occurrence. One (the Tálchir beds) contains rounded boulders chiefly of metamorphic rocks up to six feet across, embedded in fine silt, others are characterized by an intermingling of floras and faunas that give rise to a mass of contradictions; beds with a Triassic fauna overlying others with Rhætic or Jurassic floras. The Australian coal-measures and their associated beds present even a more remarkable instance of homotaxial perversity, a Jurassic flora being of the same age as a carboniferous marine fauna. Some of these beds (Hawkesbury) again contain transported boulders, which occur once more in the lower members (Ecca beds) of the Karoo formation of interior South Africa. The latter presents a striking likeness to the Gondwána system of India. In both countries a thick fresh-water formation occupies a large area of the interior of the country, whilst on the coast some marine Jurassic and Cretaceous rocks are found; and as in India, so in South Africa, the uppermost inland Mesozoic fresh-water beds are capped by volcanic.

Other examples of discrepancies in palæontological evidence might be given, but he would add merely a mention of the single case known to him in which the discordant records are both marine, namely, Barrande's "colonies" in Bohemia; but here the discordance is much less than in the cases before cited, and moreover, Barrande's conclusion is disputed by other observers.

In most of the cases he had named the conflict is between the evidence of marine and terrestrial organisms. Manifestly one or the other of these leads to erroneous conclusions, and in making choice between the two, most geologists accept evidence of the marine fossils. The reason is not far to seek. So far as he was aware, no case is known where such an anomaly as that displayed in the Gondwánas of India has been detected amongst marine formations of which the sequence was unquestioned. Further, if we compare the distribution of marine with that of terrestrial and fresh-water animals and plants at the present day, we shall find a very striking difference; and it is possible that this difference may afford a clew to the conditions that prevailed in past times.

The idea that marine and terrestrial faunas and floras were similar throughout the world's surface in past times, is so ingrained in palæontological science that it will require many years yet before the fallacy of the assumption is generally admitted. No circumstance has contributed more widely to the belief than the supposed universal diffusion of the carboniferous flora. The evidence that the plants which prevailed in the coal-measures of Europe were replaced by totally different forms in Australia, de-

spite the closest similarity in the marine inhabitants of the two areas at the period, will probably go far to give the death blow to an hypothesis that rests upon no solid ground of observation. In a vast number of instances it has been assumed that similarity between fossil terrestrial faunas and floras proves identity of geological age; and by arguing in a vicious circle, the occurrence of similar types, assumed without sufficient proof to belong to the same geological period, has been alleged as evidence of the existence of similar forms in distant countries at the same time.—*Science.*

THE GLACIERS OF NEW ZEALAND.—The June issue of *Petermann's Mittheilungen* is occupied with an elaborate description of the Tasman glacier of New Zealand, and of its surroundings, by Dr. R. V. Lendenfeld. A map is given of the central part of the Alpine region of New Zealand, showing the glaciers, water-partings, rivers and lakes. Of these glaciers the Tasman descends lowest, the river of the same name flowing from its foot at an elevation of 730 meters. From the foot of Murchison glacier (1120) meters, the Murchison river flows beside the lower part of the Tasman glacier, and unites with the Tasman river near its foot. A little lower down the Tasman river is joined by the Hooker, flowing from the foot of Hooker glaciers (802 meters). The network of streams forming the Tasman debouch in Lake Pukaki at an elevation of 523 meters. From the Godley glacier, at an elevation of 1031 meters, flows the Godley, which uniting with the McCauley from an elevation of 1333 meters, forms Lake Tekapo at a height of 743 meters. This lake receives also the Cass, flowing from the foot of the Huxley glacier. The Tekapo and Pukaki, flowing from the lakes of the same names, unite to form the Waitangi, which receives also the Ohau, itself the offspring of the Hourglass and Richardson glaciers in 1163 and 1239 meters respectively, and the Ahuriri. The Wanganui, Wataroa, Waiau, Weheka and Karangarua flow from the glaciers to the western coast. The rivers and glaciers of the western side of the Alps are shorter and smaller than those of the eastern side. The Tasman glacier is twenty-eight kilometers long, and is the largest of the glaciers of New Zealand.

THE ORIGIN OF THE MAMMALIA.[1]—The question as to the origin of the Mammalia has remained unsettled, and speculations have been divided as to whether the class has arisen by a modification of the Batrachia or of the Reptilia. Although there are cogent reasons why the descent should be from the former class, the evidence obtained up to this time from palæontology is in favor of the hypothesis of derivation from the Reptilia. The first evidence of this kind has been empirical and not conclusive.

[1] Synopsis of a paper read before the Amer. Assoc. Adv. Sci., Phila., 1884.

This consisted in the characters derived from the long bones of the limbs. Professor Owen first called attention to this resemblance in the genus Cynodraco, which is a Theromorph reptile. I next pointed out corresponding peculiarities in the bones of the American Theromorphs. I afterwards showed the resemblance between the pelvis of the Pelycosaur division and that of the Monotremata. This was followed by a demonstration of the resemblance between the coracoid of the Pelycosauria and the Mammalia Monotremata, especially to that of the genus Platypus. The present note now adds that the structure of the posterior foot approaches near to that of the Monotremata in having distinct navicular and cuboid bones, and that the astragalus and calcaneum are essentially like the corresponding part in the *Platypus anatinus*. The last two points are essential and fundamental. The three great distinctions between the Mammalia and the Reptilia in the skeleton are: (1) In the quadrate bone; (2) in the coracoid bone, and (3) in the occipital condyle. Of these the first is of less importance than has been believed, if, as maintained by Peters and others, it is to be excluded from the series of ear-bones. Its relations to the zygomatic arch in some Pelycosauria look as if Albrecht's view, that it represents part of the squamosal bone of Mammalia, is correct. The last character is weakened in importance by the fact that in some of the geckoes the condyle is double, which is due to the reduction of the basioccipital element and development of the occipital, thus agreeing fundamentally with the Mammalian condyle. The only interruption in the series which has not yet been overcome, is in the columella auris. No reptile is yet known where that element is divided into incus, orbicularis, and stapes as in the Mammalia and some Batrachia (according to Albrecht). Nevertheless the supposed columella auris, in some of the Pelycosauria, is divided at the end, so as to have two proximal termini, one of which may represent the incus. The malleus is distinct and is united by suture with the columella. In fact, most of the characters of the Batrachia, which have been cited by Huxley as indicative of the descent of Mammalia from that class, are found in the Pelycosaurian Reptilia. We give figures of these parts in the December NATURALIST.—*E. D. Cope.*

BEECHER'S CERATIOCARIDÆ OF PENNSYLVANIA.—This brochure, by Mr. C. E. Beecher, comprises descriptions of such Phyllocaridans as constitute the family Ceratiocaridæ, which have been collected in the rocks of the Chemung and Waverly groups of Pennsylvania, and is extracted from report of progress PPP, 2d geological survey of that State. Several new forms are described and well figured, and considerable structural details relating to the genus Echinocaris of Whitfield, with excellent figures on two plates. Special attention is called to the terminology, which is

illustrated by a woodcut; while a table is added giving the geological range of the genera Echinocaris, Elymocaris and Tropidocaris.

Two new genera (Elymocaris) with a new species (*E. siliqua*), Tropidocaris with three species (*T. bicarinata*, *T. interrupta* and *T. alternata*) are described, also *Echinocaris socialis*, n. sp. The illustrations are excellent. Every distinct, well preserved form of this group is of the greatest interest, and good figures of them are of special value. The point of greatest value in the paper is the identification and illustration of the mandibles, as Mr. Beecher claims them to be; they are very large, heavy and remarkably different from those of Nebalia, the existing type of the order.

NIAGARA FOSSILS.—Descriptions of a number of new species of Niagara fossils are published in the Bulletin of the Museum of the University of the State of Missouri, Vol. I, No. I, dated May, 1884, and with the above title.

The paper is written by Professor J. W. Spencer, of the University of Missouri, and contains sixty-two pages and nine plates. It is divided into three parts, as follows: Part I. Graptolitidæ of the Upper Silurian system; Pt. II. Stromatoporidæ of the Upper Silurian system; Pt. III. Fifteen new species of Niagara fossils.

The great majority of the specimens upon which the new species are based are from the Niagara shaly dolomite rocks of Hamilton, Ontario, Canada, and the types are in the private collection of Professor Spencer.

Among the Graptolites twenty new species and one new genus are described: Phyllograptus? 1, Dendrograptus 6, Callograptus 3, Dictyonema 2, Calyptograptus 2, Acanthograptus 1, Inocaulis 5, Cyclograptus (a new genus) 1; one of the new species of the Dictyonema is from the Clinton group.

Four new species of Stromatoporidæ are described from the Niagara group at Hamilton, Ontario, one from Dalhousie, New Brunswick, from the "Lower Helderberg?" group; they belong to the genera Cannopora 2, Cœnostoma 2, Dictyostoma 1.

From the Hamilton, Ontario, beds fifteen new species belonging to the following genera, are described: Palæaster, Fenestella, Polypora, Rhinopora, Clathropora?, Lingula, Discina, Crania, Pleurotomaria, Conularia, Orthoceras, Cyrtoceras, Lituites.

In regard to the Graptolites the author remarks that, "In the following descriptions I have often been compelled to depend almost entirely upon the size of the stipes and mode of branching, as the cellular structure has been obliterated in the majority of cases, even where the general form of the frond is perfectly distinct."

This remark draws attention to the evident imperfect condition of most of the specimens described and figured, which is very

unfortunate for any palæontologist who may in future have occasion to consult the paper or to identify kindred forms.

The paper will constitute No. 4 of Vol. IV of the Transactions of the St. Louis Academy of Sciences. Much careful study is exhibited in the details of the paper, and it is only to be regretted that the material at hand was of such imperfect nature.

The author regards the genus Inocaulis as a diprionidian graptolite, having found the axis central in specimens of *I. plumulosus*, this indicating a cellular system on both sides the stipe, although there is no distinct evidence of the lateral cells.

The genus Cyclograptus is established for a single discoid species with radiating stipes having central solid axes. This form is particularly interesting from its resemblance to the types of the Quebec group.

A large Conularia is described under the name *C. magnifica*, similar to but much larger than *C. niagarensis*. The specimen, if perfect, would be twenty-four centimeters long.

The author informs us that "the long buried treasures of the former geological survey of the State" (Missouri) have been unearthed.

It would be of value to science if some future Bulletin of the Museum would publish a list of the species contained in the museum which served as types for the numerous species described by Messrs. Shumard, Swallow, Norwood and others from the State of Missouri.—*H. S. Williams.*

GEOLOGICAL NOTES.—*Cambrian.*—Dr. Lehmann, whose quarto volume on the crystalline schists of Saxony is an important contribution to European geology, has abandoned the "Archæan" theory of the origin of these rocks. Below the Post-tertiary deposits of Saxony lies a central elliptic core of granulite rock, around which are grouped zones of various schistose rocks, passing outwards into the normal clay-slates of that part of Germany. On their south-eastern margin these rocks are unconformably overlaid by Silurian and Carboniferous rocks, but on the north-west a conformable sequence is traceable from the schists and slates upwards into Cambrian and Lower Silurian rocks precisely like those of the adjacent countries. Dr. Lehmann has come to the conclusion that the whole of the crystalline schists within the granulite area are metamorphosed Palæozoic sediments, originally of Cambrian or Silurian age. Their metamorphism probably took place during the crumpling and upheaval of the area, which took place later than the Devonian and older than the Carboniferous period. In the progressive intensity of metamorphism the most prominent fact is the corresponding advance in the development of mica. At the same time the muscovite, which alone is present in the outer parts of the area, is replaced further inwards by biotite. Where the crumpling is greatest most biotite occurs.

Dr. Lehmann believes that gabbro is an eruptive rock, younger than the granulite but older than the granite. It has been involved in the general metamorphism, and so has assumed schistose modifications. The Geological Survey of Scotland has recently arrived, independently, at similar conclusions with regard to the diorites and amphibolites of Aberdeen and Banff. The problem in Europe is linked with that presented by similar rocks in this country.

Devonian.—Dr. J. S. Newberry not long ago described the new placoderm genus Myzostoma, with two species, *variabilis* and *terreli* (Trans. N. Y. Acad. Sci. 1883). The teeth consist of strong and massive tables of bony tissue resembling enamel above, and disposed in pairs in both jaws. Those of the lower jaw are three to six inches long, and more than an inch wide. They resemble the teeth of Ceratodus. Only the teeth are yet known.

Carboniferous.—F. Roemer (Zeit. der Deutschen geol. Gesell.) describes *Belinurus silesiacus* from the coal measures of Upper Silesia. The cephalic shield is broad and strongly curved, terminating laterally in two horns, and the abdominal shield is short.

Cretaceous.—Dr. G. Schweinfurth (Zeit. der Deut. geol. Gesell.) contributes a geological map of the strata of the Mokattam mountains, near Cairo, showing the nummulitic Cretaceous strata, the Eocene strata with few nummulites, and the Pliocene red sandstone, rich in pholades.——W. Dames (Zeit. der. Deut. geol. Gesell.) contributes a monograph of the genus Ancistrodon. The teeth called by this name are pharyngeal teeth. As the genus is only found in marine beds, it can scarcely be cyprinoid, and among known pharyngeal teeth belonging to marine teleosteans, the only one resembling Ancistrodon are those of Balistes. But Plectognaths seldom occur in the older formations, whereas Ancistrodon is found in two formations and in both hemispheres. No well-grounded conjecture as to the exact relationships of these teeth can be made. Five species are enumerated, viz., *A. mosensis, libyanus, texanus, armatus* and *vicentinus*, all except the fourth of which are new. The first three are from the Cretaceous of Maestricht, the Lybian desert and Texas respectively; *A. armatus* is from the Eocene of France and Egypt, and *A. vicentinus* from the Oligocene of Upper Italy.——The coals and lignites of the Canadian Northwest are, according to Dr. G. M. Dawson, all of Cretaceous or Tertiary age. The only region yet examined in detail by the Geological Survey of Canada is the extensive one near the Bow and Belly rivers, from the base of the mountains to about the 111th meridian. Anthracite occurs where the Cretaceous rocks have been much disturbed and folded, but on the plains, away from the mountains, the coal assumes more or less the character of lignites.——The thesis presented

by M. de Lacvivier on his admission as doctor of the faculty of sciences, upon the Cretaceous beds of l'Ariège, is the result of many years of labor. The strata below the Cretaceous are not neglected. The writer describes new and interesting Devonian beds which he has discovered, chiefly marbles with remains of Goniatites. The Carboniferous is absent in the department, but the Trias and Jurassic are present, and to the latter must be referred a mass of dolomites and marbles which were previously believed to be Palæozoic, but which contain Jurassic fossils. The uneven surface of the Jurassic beds is filled by a ferruginous deposit (bauxite) forming the base of the Urgonian, which is succeeded by the Gault. Many new fossils are described from the Urgonian, and the Gault is highly fossiliferous. The Upper Cretaceous (Cenomanian, Turonian, Senonian) is completely uncomformable with the Lower.——Some pieces of pumice, thought to have come from Krakatoa, have been picked up at Mayotte, off the north-west coast of Madagascar.

Tertiary.—M. E. van den Brock has discovered fragments of Scandinavian rocks in the Post-tertiary deposits of Belgium. The only known piece large enough to be called an erratic block is of granite, measures $0.8 \times 0.5 + 0.6$ meters, and is imbedded in the fine Campinian sands of Wortel.

General.—A hundred and twenty pages of the Annales des Mines (1884, 2e livraison) are occupied by a study of the stratigraphical geology of the Hartz mountains, with especial reference to the plutonic rocks, diabases, porphyries, gabbros, granites, and to their enclosed metalliferous veins.——F. Kollbeck contributes to the Zeit. der Deut. geol. Gesell. an account of the extensive porphyritic rocks of Southern China.——Messrs. Steenstrup and Lorenzen (Zeit. der Deut. geol. Gesell., 1883) after a study of the so-called meteoric masses of iron in Greenland, conclude that these masses are telluric, and that the presence of nickel can no more be considered as an infallible evidence of meteoric origin.

MINERALOGY.[1]

New Minerals.—*Rinkite*[2] (Lorenzen).—Joh. Lorenzen, of Copenhagen, has given this name to a new mineral from Kangerdluarsuk in Greenland, in honor of Dr. Rink, recently director of the Danish Explorations in Greenland.

It occurs in crystals with arfvedsonite, ægirite, eudialite, steenstrupite, lithia mica, etc.

Monoclinic. Color golden-brown. Translucent in thin splinters, when unaltered; straw-yellow and earthy when altered. Hardness 5. Specific gravity 3.46.

[1] Edited by Professor H. Carvill Lewis, Academy of Natural Sciences, Phila.

[2] *Zeitsch. für Kryst.*, 1864, IX, p. 248.

A mean of five closely accordant analyses gave:

Fl	SiO_2	TiO_2	CeO	LaO	DiO	YO	FeO	CaO	Na_2O	
5.82	29.08	13.36		21.25		0.92	0.44	23.26	8.98	= 103.11

The formula as deduced is:

$$2\,\overset{II}{R}\,\overset{IV}{R}\,O_3 + NaFl$$

wherein $\overset{II}{R}$ = Ce La Di Y Fe Ca

and $\overset{IV}{R}$ = Si Ti

Before the blowpipe it is fusible with difficulty to a black cinder. It dissolves in borax in the oxidizing flame to a bead which is deep yellow when hot, pale yellow when cold. In the reducing flame it becomes colorless when cold. In salt of phosphorus it shows a skeleton of silica, and gives the same reaction when hot as with borax; when cold, after heating in the reducing flame, it becomes violet. Supersaturation of the bead makes it opaque white. These reactions are due to titanium and cerium. It is decomposed by weak acids, with separation of silica and titanic acid.

The crystals exhibit in polarized light a twinning structure parallel to the orthopinacoid. This structure is also shown by the occurrence of fine striations on the orthodomes and prism.

Polylithionite[1] (Lorenzen).—At the same locality a lithia mica occurs in handsome pale green or white six-sided tables imbedded in albite. These tables are divided into sectors by fine lines or striations resembling those of zinnwaldite (lepidolite). The plane of the optic axes is at right angles to the striations, and shows the crystals to be composed of three or six individuals. The angle between the bisectrix and the vertical to the base is somewhat greater than that given for zinnwaldite, although practically their optical properties are identical. The other characters of the two micas are very similar.

Chemically the mica from Greenland has a larger percentage of fluorine and of lithia and less alumina than most lepidolite.

A mean of three analyses gave:

Fl	SiO	AlO	FeO	K_2O	Na_2O	Li_2O
7.32	59.25	12.07	0.93	5.37	7.63	9.04

The name polylithionite refers to its large per centage of lithia. The mineral, however, is not sufficiently distinct from lepidolite to warrant giving it a specific name, and should be regarded merely as a variety of that mica.

Goyazite[2] (Damour).—In the diamond-bearing sands of Minas Geraes, Brazil, certain rounded, transparent grains of a pale yel-

[1] *Zeitsch. für Kryst.*, 1864, IX, p. 251.
[2] Bull. Soc. Min. de France, 1884, VII, No. 6, p. 204.

low mineral occur which Damour has shown to belong to a new species. The grains have an easy cleavage, and in the polariscope exhibit a cross and series of rings, such as would be given by a section of a uniaxial mineral. The hardness is that of apatite, the specific gravity 3.26.

Heated in a matrass it gives off water and becomes white and opaque. Thin splinters can be fused in the blowpipe flame. Moistened with nitrate of cobalt, a blue color is obtained. It is not attacked by acids.

Composition:

P_2O_5	Al_2O_3	CaO	H_2O	
14.87	50.66	17.33	16.67	= 99.53

The formula P_2O_5 5 Al_2O_3 3 CaO + 9 H_2O is deduced.

The name is taken from that of the province containing the principal diamond localities.

Hillangsite[1] (Igelström).—Igelström has found what he believes to be a new mineral in large quantities at the iron mine of Hillang, in the parish of Ludvika, Sweden. It occurs with garnet, magnetite and igelströmite. It resembles the anthophyllite of Texas, Pa., and the kupfferite of Delaware county, Pa., as also foliated rhodonite; but it is colorless and transparent. Sometimes the mineral is impregnated with microscopic crystals of magnetite, when it becomes black. It has a characteristic nacreous or silky luster, and is white when pure. Hardness = 6. It fuses with difficulty to a slightly magnetic scoria, gives reactions for manganese, and is not dissolved by acids.

As seen by the following analysis it is essentially a bisilicate of the protoxides of iron and manganese:

SiO_2	FeO	MnO	MgO	CaO	
48.25	28.17	12.08	5.86	3.22	= 97.58

According to Bertrand the optical properties are those of the amphiboles. The two cleavages make an angle like that of amphibole, the form is monoclinic and the orientation of the axes is like that in the amphiboles. The composition is also clearly that of an amphibole. Similar species have already been described under the names of silfbergite, dannemorite, asbeferrite. This mineral differs so slightly from these varieties of hornblende that a new name does not seem to be necessary.

PHOTOGRAPHY AS APPLIED TO MINERALS.—An excellent illustration of the good results that may be obtained from photographs of minerals may be seen in the last number of the Transactions of the Academy of Science of St. Louis.[2] Mr. A. V. Leonhard has illustrated a paper on the occurrence of millerite in St. Louis with some photographs of that mineral reproduced by

[1] Bull. Soc. Min. de France, 1884, VII, No. 6, p. 232.
[2] Vol. IV, No. 3, p. 493, 1884.

the artotype process, and it is at once seen how far superior such views are to any drawings. The mineral itself seems before us. In one picture a calcite crystal is pierced by a spear of millerite. In another a beautiful radiating tuft of needle-like crystals of millerite fill a cavity in the limestone. Four pictures in all are given, these being by far the most valuable part of the paper.

While an outline drawing is undoubtedly necessary for the representation of the precise crystalline form of any mineral, such a drawing, always to some extent conventionalized, may give no idea at all of the natural appearance of the mineral. For purposes of determination, and especially for illustrating fine specimens, it is probable that photography will, before long, be made use of. A complete set of photographs of typical specimens would be highly valued by mineralogists.

SZABOITE.—In 1878 Professor A. Koch published a description of a Transylvania mineral which, occurring in minute, thin, tabular crystals in cavities in andesite, he named *szaboite*, in honor of Professor J. Szabó, of Budapest. The mineral was described as triclinic, and as related in composition to babingtonite.

J. A. Krenner, of Budapest, has recently published an extended article[1] on szaboite, in which he comes to the conclusion that szaboite is not a distinct species, but merely a variety of *hypersthene*. A careful optical examination showed identical properties with hypersthene. Crystallographically he found it to be orthorhombic, not triclinic. The cleavage, the plane of the optic axes and bissectrix, the axial dispersion and the pleochroism are all identical with those of hypersthene. The hardness and specific gravity are also similar. Chemically it appears that Professor Koch was both mistaken as to the state of oxidation of the iron, the iron existing as protoxide, not sesquioxide, as he thought, and also that his analysis failed to give the full percentage of magnesia.

Since the proportions of iron and magnesia are variable in hypersthene, and may replace one another, it is held that the only question is as to the precise variety of hypersthene to which szaboite belongs.

MINERALOGICAL NOTES.—A Text-book of Descriptive Mineralogy, by Hilary Bauermann, of the Royal School of Mines (London), has just been issued as a companion volume to his Textbook of Systematic Mineralogy, already noticed in the NATURALIST. The present volume is a concise presentation of the characters of all the principal minerals, and will be valuable to the class for which it is intended.——An amateur mineralogical journal published monthly "in the interest of mineralogists and collectors of antiquities of all kinds," and entitled *The Young Mineralogist and Antiquarian*, has reached its second number. The edi-

[1] *Zeitsch. für Kryst.*, IX Band, 3 Heft, 254.

tor, Mr. T. H. Wise, of Wheaton, Ills., is a boy seventeen years of age. The journal is very creditable, and will doubtless be useful to young collectors.——A. V. Leonhard has published in the Transactions of the St. Louis Acad. Science a descriptive catalogue of the minerals of Missouri and a list of the more important localities of minerals in that state.——Dieulafait has examined the so-called "*cipolin marbles*," which occur in lenticular beds in gneiss in various parts of the world. He finds that a trace of manganese is invariably present, and argues from chemical reasons that these marbles and the surrounding gneiss are contemporaneous deposits. Geological investigations have led to the same conclusion.——*Amalgam* has been found at the Friedrichssegen mine near Oberlahnstein. Specimens of native silver and native copper from the same locality have been found by Sandberger to contain traces of mercury.

BOTANY.[1]

SELF-PLANTING OF SEEDS OF PORCUPINE GRASS.—In connection with the two notes relating to the fruit of the porcupine grass, it may not be without interest to state that while engaged in geological work in Dakota, north of the Northern Pacific R. R., we were much annoyed by the fruit of this grass. Indeed I found the only way to walk with comfort through this grass was to roll my pants above my knees and my socks down over my shoes.

I also observed, on several occasions, these seeds planted two inches deep in the soil with the awn protruding from the ground. It is plain that with the point of one of these fruits once entered below the surface of the soil the swelling and shrinking, due to varying amounts of moisture, would work the seed directly into the ground.—*F. H. King, River Falls, Wis.*

THE ADVENTITIOUS INFLORESCENCE OF CUSCUTA GLOMERATA.—The flowers of this dodder are in dense clusters, which at maturity are so much crowded that it is impossible to make out their mode of origin, hence they have been described as cymose, panicled or as densely clustered, with no hint or suggestion as to their adventitious origin. A study of their development the past season shows them to be strictly adventitious and, as a consequence, endogenous as to origin.

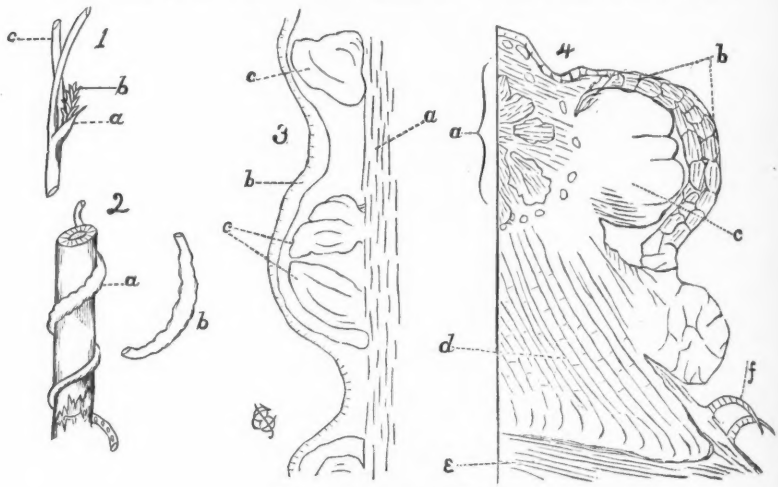
A short time before the flower clusters appear the dodder stems, which are in close contact with their hosts, begin to broaden, as shown in Fig. 2, eventually becoming slightly lobulated. If at this time a longitudinal section of the stem be made, the cause of the broadening will be found to be in the development of numerous adventitious buds from the lateral fibro-vascular bundles. The appearance of these is shown in the outline sketch, Fig. 3, which is reduced from a camera sketch. In a cross-section of the stem

[1] Edited by PROF. C. E. BESSEY, Ames, Iowa.

essentially the same condition is shown at this time (Fig. 4). In both figures the epidermis and the sub-epidermal or cortical tissues are shown to be pushed out by the developing buds.

As the buds increase in size the epidermal and cortical covering is pushed out more and more until at last it is ruptured somewhat regularly along each side, and the free portions then folded and crowded back by the mass of buds. Fragments of this covering may be seen on the top and sides of the stem in a fully developed cluster of flowers, by careful dissection.

Here and there on the stem may be found, at about the beginning of the development of the adventitious buds, small and rudimentary buds which evidently represent the normal flowering branches (Fig. 1 *b*). These grow from the axils of bracts, and



EXPLANATION OF THE FIGURES.

FIG. 1.—Portion of a stem of *Cuscuta glomerata*, natural size, bearing a bract, *a*, from whose axil there grows an abortive flowering branch, *b*, as well as an ordinary branch, *c*.

FIG. 2.—A fragment of a sunflower stem, with a dodder encircling it, the latter enlarged at *a* (shown separately at *b*) by the formation of adventitious buds (all natural size).

FIG. 3.—Outline sketch of a small portion of a longitudinal section of *b*, Fig. 2, showing at *a* the fibro-vascular bundle of the dodder stem; *b*, the epidermis and cortical tissues which have been pushed out by the adventitious buds *c c c* (magnified).

FIG. 4.—Outline sketch of half of a cross-section of the above, more highly magnified; *a*, the fibro-vascular cylinder of the stem; *b*, epidermis and cortical tissues pushed out by the adventitious bud, *c*; *d*, section of a sucker; *e*, tissue of sunflower stem; *f*, hairs of sunflower stem.

while I have not been able to make out the parts of the flowers, there can be little doubt, from their position and general struc-

ture, that they really are rudimentary flowers or flower-clusters, homologous with those of many other dodders as well as those of the morning glories.—*C. E. Bessey.*

BOTANY IN THE A. A. A. S.—The botanical papers read during the recent meeting of the American Association for the Advancement of Science, in Philadelphia, were as follows:

The affinities of Dionæa. By Joseph F. James.

A botanical study of the mite gall on the petiole of *Juglans nigra*. By Lillie J. Martin.

The torsion of leaves. By W. J. Beal.

The fossil flora of the globe, three papers. By Lester F. Ward.

Polarity of the leaves of *Erigeron canadense*. By W. J. Beal.

Utricularia vulgaris, with young teleostean fishes entrapped in the bladder-traps of that plant. By H. N. Moseley.

The influence of cross-fertilization upon the development of the strawberry. By Wm. R. Lazeuby.

Stomates on seeds. By Geo. Macloskie.

The adventitious inflorescence of *Cuscuta glomerata*. By C. E. Bessey.

Demonstrations of perforations in the cellular-walls of plant cells. By Louis Elsberg.

The last named paper was, by a curious ruling of the standing committee, assigned not to the section of biology where the botanists were, but to the section of microscopy where the botanists as a rule *were not*.

In addition to the foregoing there were many papers and notes presented to the Botanical Club of the association. The meetings and excursions of the club were most enjoyable and profitable, and many of the plant-lovers of the country had in these the opportunity of making the personal acquaintance of long known but not previously seen correspondents. The joint meeting of the Botanical Club and the Botanical Section of the Philadelphia Academy of Natural Sciences on the evening of September 8th was fully attended. Dr. Asa Gray presided during the formal part of the meeting, in which short addresses were made by many of the principal botanists in attendance.

The Botanical Club was a noticeable feature of the association, and the perfection and compactness of its organization called forth much favorable comment.

NEW SPECIES OF NORTH AMERICAN FUNGI.—*Exobasidium symploci.*— Receptacle lemon-yellow, subglobose and sublobate, 3–3½^{cm} in diameter; conidia hyaline cylindric, nearly straight, 15–21 × 2μ. In distorted flower buds of *Symplocos tinctoria*. Cove Springs, Fla., March, 1884.

Dermatea sabalidis.—Thin, cup-shaped, clustered or scattered, tobacco-brown, 350-450μ in diam. Asci subsessile, 35 × 5μ; sporidia 2-3 seriate, oblong or clavate-oblong, yellowish, 2-nucleate, 4-6 × 1-1¼μ. On dead petioles of *Sabal serrulata*. Cove Springs, Fla., January, 1884.

Asterina subcyanea.— Perithecia hypophyllous, superficial, depressed convex, 250-350μ in diam., of cellular structure, the cells subspherical, 5-7μ in diam., of a deep greenish-blue, connected in a moniliform manner and extending out from the base of the perithecium on all sides so as to form a thin membranaceous border closely appressed to the surface of the leaf; ostiolum papilliform, collapsing when dry and with a broad circular opening; asci slightly narrowed at each end, sessile, 75 × 15μ; sporidia biseriate, oblong-clavate, uniseptate, hyaline, 20 × 5-7μ. On living leaves of *Quercus laurifolia.* Cove Springs, Fla., March, 1884.

Asterina discoidea.—Perithecia hypophyllous, orbicular, slightly depressed in the center, olivaceous, thin, ½-¾^{mm} across, with an indistinct reticulated margin; asci obovate or globose, 30-40 × 30-35μ; sporidia crowded, clavate-oblong or pyriform, uniseptate, 12-16 × 4-5μ. Much resembles *Asterina intricata* E. & M., but color different, asci of a different shape and sporidia larger. On living leaves of *Quercus laurifolia.* Cove Springs, Fla., March, 1884.

Asterina lepidigena.—Perithecia black, subglobose, at length applanate, very thin and fragile, 200-300μ in diam., seated on a hyaline scanty mycelium; asci ovate, 8-spored, 30 × 15μ, or longer and narrower, 42 × 12μ; sporidia obovate, hyaline, biseptate, about 12 × 4μ. Attached to the epidermal scales on living leaves of *Andromeda ferruginea.* Cove Springs, Fla., March, 1884.

Asterina pustulata.—Perithecia imperfectly developed, flattened, 200-500μ across, consisting of a central nucleus of loosely compacted, subglobose, brown cells which, around the circumference, pass into a fringe of closely packed brown, branching hyphæ and forming altogether a circular membranaceous disk (½-¾^{mm}) on the surface of the leaf; asci subglobose, 8-spored, 55μ in diam.; sporidia obovate, hyaline, uniseptate, 30-40 × 10-12μ. On leaves of *Quercus laurifolia.* Cove Springs, Fla., March, 1884.

Ascomycetella floridana.—Hypophyllous; perithecium wanting; asci compacted in yellowish-white specks 500-600μ in diameter, with a subradiate-floccose margin; asci obovate, 75 × 18μ; sporidia clavate-cylindric, multiseptate, 40-45 × 6-7μ. On leaves of *Quercus laurifolia.* The fungus first appears as a mere white floccose speck, barely visible to the naked eye, but soon increasing in diameter and becoming more compact and of a pale cream color. This is evidently referable to Professor Peck's genus Ascomycetella, but is quite distinct from his *A. quercina.* Cove Springs, Fla., winter of 1884.—*J. B. Ellis, Newfield, N. J., and Dr. Geo. Martin.*

Botanical Notes.—Experiments lately made by Dr. Stalker, the State veterinarian of Iowa, prove that *Crotalaria sagittalis,* the Rattle-box, is a "loco-plant." In the Missouri valley it is

greedily eaten by horses, and produces great nervous and muscular disorder, in most cases resulting in death.——J. C. Arthur's Contributions to the flora of Iowa, VI, in the Proc. Davenport Acad. Nat. Sci., Vol. IV, adds twenty-four phanerogams to the previous lists, and now for the first time enumerates the pteridophytes, thirty-four in number. Of the latter twenty-three are ferns.——The Journal of the Linnean Society for August contains a curious plate representing pollen cells and an anther of a poppy (*Papaver rhœas*) from a funeral garland from the coffin of an Egyptian princess of the twenty-first dynasty, that is about 1000 B.C. Both pollen-cells and anthers appear to be slightly larger than those of recent plants, but otherwise the resemblance is very close.——H. N. Patterson, of Oquawka, Ill., has issued a neat Check-list of North American Gamopetalæ made to agree with Gray's Synoptical Flora. It will be a convenience in the herbarium.——J. C. Arthur has observed a distinct polarity in the leaves of garden lettuce, according to a note in the *Botanical Gazette*.——Dr. F. Hauck's *Meeresalgen*, being the second volume of the new edition of Rabenhorst's Kryptogamen Flora, has reached part VIII, which contains the Phæozoösporeæ, Oösporeæ and Chlorozoösporeæ.——Luerssen's *Farnpflanzen* (Vol. III of Rabenhorst) has reached part III, devoted to a continuation of the Polypodiaceæ. The illustrations in both the foregoing are most excellent.

ENTOMOLOGY.

MODE OF OVIPOSITION OF THE COMMON LONGICORN PINE BORER (*Monohammus confusor*).—The exact mode of deposition of their eggs by the longicorn beetles is not well known, so far as we are aware. We have been fortunate enough to observe the female beetle while at work making the incision with her jaws, though we have not observed the act itself of deposition of the eggs. While examining the fir trees on the western shores of Birch island, Casco bay, Maine, on a warm sunny afternoon of August 30th, I saw a male *Monohammus confusor* standing on the bark of a living fir about nine inches in diameter, within the distance of less than two inches from a female, whose jaws were buried in the bark of the tree on the western side of the trunk which was exposed to the full rays of the sun.

On beginning to make the incision each of the large sharp strong jaws of this beetle are pushed directly into the bark; they are then apparently brought together, and the result is a slight curvilinear gash which descends obliquely in the bark. It is probable that the beetle pries up the pad thus formed, so that the freshly cut edges are exposed, and an opening is thus formed into which the egg is thrust. While watching the female at work the male dropped to the ground, and his consort, becoming alarmed, withdrew her jaws from the incomplete incision, when I seized

her. To the end of her abdomen were attached a few fragments of the reddish inner bark of the fir, and two or three small green pellets, probably excrement; but this showed that she had already deposited at least one egg, and that the labor of oviposition was slight, the end of the abdomen probably being simply extended and thrust into the gape of the incision.

By prying up the pad formed by the jaws, a shallow but roomy cell or chamber is made for the egg, which lies nearly or quite horizontally, not vertically, to the trunk of the tree.

The egg is very large, ovo-cylindrical, well rounded but tapering somewhat at each end, of a dirty white color, and in length is $4\frac{1}{2}^{mm.}$

On visiting the tree a week later and removing a portion of the bark and examining it Sept. 6–8, the eggs had in some cases hatched and the larvæ had begun to descend slightly into the bark. On hatching they begin at once to gnaw a mine, throwing their castings out through the gash originally made by the female, so that it was easy to ascertain, without disturbing the bark, whether the eggs had hatched or not. The larva indifferently lies with either side, dorsal or ventral, presented outwards. Three days after (Sept. 12) several had bored through the pieces of bark making the usual flattened oval hole, but probably in nature the larva remains hidden in the bark through the winter, not beginning to penetrate the wood until the following spring.

The length of the larva when freshly hatched was $5–6^{mm.}$ and the body was rather stouter than in the full-grown larva.

How many eggs are laid by the female is not known, but probably, judging by their large size, comparatively few.

Another female was found on the same tree. Over a hundred gashes had been made on the western side of this fir tree over a space four feet long. The gashes were so fresh that they must have been made on that and a few previous days. They were quite conspicuous and could, after one had become familiar with their appearance, be detected at the distance of at least five or six feet from the tree. I suspect that the sexes couple frequently during the operation of egg laying, as the male was standing so near his mate with his antennæ outstretched and intently watching the female while at work. The males are also probably polygamous.

The industry of the females is well shown by the number of the gashes made, some of which did not however contain any eggs. In the space of a square inch there were three gashes, while in the region where they were thickest, forty were counted in half a square foot. Of course when they hatch all do not live to pass through their transformations. Whether the woodpecker seeks for and discovers the larvæ while encased in the bark is doubtful, and yet it would be easy for these or other birds to pick the grub out of their hiding places. So far as my observations have

gone, the holes made by the woodpecker in forest trees are for the purpose of getting at the inner bark rather than for insects. But a careful examination in September of woodpeckers shot in coniferous forests would throw light on this subject.

In regions where the white pine grows, it is infested by this Monohammus. The spruce is also often infested, but I have not seen clear cases where either of those trees have been killed outright by this destructive borer. But during the past summer I have seen on the islands in Casco bay, and taken out the full-grown larvæ from at least six or seven living firs, which must have been killed by the attacks of this borer, which has been the evident cause of the death of many firs in Maine. I have also been told by lumbermen that fir trees are killed by this borer. Near Rangely, Maine, an extensive tract of firs was killed outright, I was informed, by "the borer," undoubtedly this beetle.

I have seen hundreds, perhaps nearly a thousand, dead firs whose trunks were riddled with the holes of these borers. The spruce is less frequently killed, but I have taken from a dead tree two pieces of spruce bark, each about six inches square, one containing sixteen and the other eighteen holes, through which the beetle had escaped.—*A. S. Packard.*

Egg-laying Habits of the Maple-tree Borer.—Fresh from the foregoing observations I looked, Sept. 12th, for the eggs or freshly hatched larvæ of *Glycobius speciosus*, and found the latter at once. The Rev. Mr. Leonard, of Dublin, N. H., many years ago, in a letter to Dr. Harris, stated that the maple-tree borer, on hatching, remained in the bark through the winter. Upon examining a rock maple about two feet in diameter, it was found that twenty eggs had been laid in different parts of the bark from near the ground to where the branches originated, a distance of about ten feet. The site of oviposition was recognized by a rusty irregular discoloration of the bark about the size of a cent, and especially by the "frass" or castings which to the length of an inch or more were attached like a broken corkscrew to the bark. On cutting into the bark the recently hatched larvæ 5–7 ^{mm} in length, were found lying in their mine or burrow at the depth of from a tenth to the sixth of an inch.

The burrows already made were about an inch long, some a little longer; the larva usually mines upward. No eggs were found, but they are laid in obscurely marked gashes about a fifth of an inch long, usually near a crevice in the bark. These gashes and castings are readily discoverable, and it would be easy to save these valuable shade trees by looking for them in the autumn and winter or early spring, and cutting them out. The beetles were not uncommon at Brunswick in July and August of the past year.

Of six grubs which I cut out one half seemed unhealthy, perhaps diseased by the water which had penetrated their mine.

I have recommended protecting valuable shade trees by wrapping the trunks with bands of cloth well saturated with kerosene oil, in August and September, so as to drive off the beetle, and to destroy the freshly hatched grub, but since discovering how easily the gashes and castings of the freshly hatched worms can be detected a few days or weeks after the eggs have been laid, it seems obvious that the easiest and surest preventive is to cut out the grubs when laying in their autumn and winter quarters just under the surface of the bark.

It is almost impossible to destroy the fully grown worms in their "mines" or burrows, since the latter extend up the tree either directly under the bark or sunken in the wood. On one tree, nearly destroyed by this borer, out of about fourteen mines, twelve extended upward. Hence it is useless to try to find the hole and inject oil into it. There now seems no reason why valuable shade maple trees should not be saved by an hour's close observation and removal of the young grubs, say in September or October.—*A. S. Packard.*

PALMEN'S PAIRED OUTLETS OF THE SEXUAL ORGANS OF INSECTS.[1]—In an investigation of this kind it is natural that the anatomist should seek the most primitive condition of almost any organ in insects, in that primitive generalized group, the Pseudoneuroptera and especially the Ephemerina. The double nature of the oviducts and male outlets in this group had been slightly indicated by Swammerdam and Burmeister, but Palmén in this elaborate and learned essay has thrown much new light on the subject and reaches some most interesting conclusions. The work is divided into five chapters, the first being introductory and being a history of entomotomy. In the second chapter the opinions of the earlier authors on the sexual organs of the Ephemerina are given, and in the third chapter the author's own very complete observations are recorded, while in the fifth chapter the ovaries and oviducts of other insects, principally certain Pseudoneuroptera, Orthoptera and Neuroptera, are described. The drawings and microscopic sections are well rendered, and on plate v are given useful diagrammatic figures illustrating the morphology of the ovaries and oviducts of selected types of the lower orders of insects as compared with the ovaries and segmental organs of the worms and Crustacea.

Professor Palmén's conclusions, drawn from his studies on the Ephemeridæ, are as follows:

1. The genital ducts are in both sexes throughout their whole extent independent of each other and also paired. Their terminal sections become united only by the integument itself under

[1] Ueber paarige Ausführungsgänge der Geschlechtorgane bei Insecten. Eine morphologische untersuchung. V on J. A. Palmén. Mit 5 tafeln. Helsingsfors, 1884. 8vo, pp. 108.

them; in the males the two ducts open out in the partly formed outgrowths of the integument forming the two penes; in the females they are united by means of a transverse ingrowth of the integument, the genital intersegmental fold.

2. The entire apparatus consists also of two heterogeneous components: internal parts which are developed from the genital germs of the embryo, and are simply cellular, and external, tegumental parts (the chitinous cuticula) which slough off during growth.

These two components arise from two different sources: the internal are differentiations of the embryonic epithelium of the body cavity; the external, like the integument generally, originate directly from the epiblast of the embryo.

3. In the terminal section of the passages leading outward (ductus ejaculatorius and the oviduct) no chitinous cuticula has been observed.

4. The male ducts open behind the ninth, the female behind the seventh abdominal segment.

5. In the passages leading out, the principle of division of labor is only partially carried out. Accordingly the corresponding sections of the ducts differ little from each other morphologically, and differentiations in the shape of peculiar forms of appendages are, as a rule, not present.

As regards the fourth point the Ephemerina differ from other insects (in which it opens behind the eighth) in having the oviduct open behind the seventh abdominal segment. This indicates, Palmén thinks, a high phyletic age for this group.

Graber's statement that the sexual passages in the pupa of Chironomus are paired, is referred to, and Palmén adds that this is the case with Corethra and other dipterous pupæ. Finally it appears that anatomical and embryological modes of investigation have brought about similar results.

THE NATURE OF THE SO-CALLED "LIVER" IN THE ARACHNIDS.—We have received from Dr. Bertkau his final essay on this interesting subject, and translate his conclusions. The original appears in the Archiv für mikroskopischer Anatomie, band 23, 1884.

The "liver" of spiders so develops that the enlarged part of the digestive tract in the base of the abdomen forms a considerable number of smaller and larger outgrowths, which branch out more and more, and through an intermediary tissue becomes united into an anatomical unity.

Among the outgrowths of the digestive tract are five of considerable extent; one is situated in front on the under side of the intestinal tract; the rest are arranged in pairs behind on the upper side; the hindermost pair are at first narrow and have in their walls muscular fibers (?). The outgrowths, like the part of the digestive tract, where they arise are of a glandular nature.

Among the epithelial cells are to be distinguished two kinds, smaller oval cells filled densely with large colorless nuclei, and larger club-shaped ones whose contents, among other things, consist of small crystals and larger drops of yellow, brown, green colors.

The principal effect of the secretion of these glandular cells is the solution and digestion of fibrin, digested protoplasm, etc.

The spiders take no solid nourishment. They dissolve the assimilable, solid constituents of their prey, muscles, etc., and they suck the flowing blood. This passes into the ultimate branches of the intestinal outgrowths. The hind gut or terminal section of the digestive canal begins immediately behind the last pair of the intestinal outgrowths or diverticula.

The malphigian vessels are dispersed through the intermediate tissue. Their excretions are guanin or an allied substance. The same or an allied substance is found in many kinds, both deposited in the external layer of the intermediate tissue and distributed prominently in the coloring and markings of animals.

In the present condition of our knowledge it is fitting to supply the name "liver" in the Arachnida by "chyle-stomach."

We do not feel entirely satisfied with the last main conclusion. The same mode of reasoning might be applied to the vertebrate liver, which is composed of diverticula of the chyle-stomach. There seems to us no good reason for not, as a matter of convenience, applying the term "liver" to the enormous glandular outgrowths of the Arachnidan chyle-stomach. To confound the "liver" of a spider with its source, the chyle-stomach, is not, we would suggest, good morphology. Moreover, embryology shows that the diverticula are secondary outgrowths from the mid-gut of the embryo, which becomes finally the chyle-stomach of the adult animal.—*A. S. P.*

The Systematic Position of the Embiidæ.—It will be remembered that this singular group of insects is usually placed next below the white ants (Termitidæ). Mr. J. Wood-Mason has added to our knowledge of these insects, and concludes as follows regarding their affinities: "In anticipation of the full and detailed account of the numerous and important differences between them and the Perlidæ which is in preparation, and will be published as soon as the drawings needed to render my descriptions intelligible are ready, I may say that the Embiidæ undoubtedly belong to the true Orthoptera, that they are in my opinion in some respects the lowest term, and in others the lowest term but one, of a series formed by the families Acridioidea, Locustidæ, Gryllidæ and Phasmatidæ, and that their resemblances to the much lower Perlidæ, which may well be direct descendants of a form closely related to Campodea, are due to their low position in the division of Orthopterous insects to which they belong, and

do not imply any such close genetic relationship to them as has been suggested" (Proc. Zool. Soc. London, 1884).

Mr. Mason has detected the females, before unknown, which are wingless and of larger size than the males. He also discovered in India larvæ of a species apparently living in society.

ENTOMOLOGICAL NOTES.—A case of sexual attraction in Prionus is noticed by Anna K. Dimmock in *Psyche* for April. A female about to oviposit was caged, when one male after another flew to the cage, so that a great many males were taken in the afternoon. "On account of the presence of so many males a number of females made their appearance, showing an attraction of the female to the male, like that above noted of males attracted by females." Apropos of this fact, Mr. F. Clarkson states in the *Canadian Entomologist* for May, that the presence of *Prionus brevicornis* is quickly realized by the odor of the female, which is very powerful and can readily be detected twenty feet distant. "I placed a female immediately after emergence in an uncovered jar, and wherever I positioned it, on the piazza or elsewhere, the males were attracted from every direction. I captured twenty males in a very few minutes."——Mr. W. H. Edwards contributes to the *Canadian Entomologist* for May, useful directions for breeding butterflies from the egg.——M. Jules Künckel has communicated to the Paris Academy of Science, as the result of his researches upon the movements of the heart in insects during their metamorphosis, the statement that this organ continues to beat during the phenomena of histogenesis. In *Volucella zonasia* and *Eristalis æneus* it was observed that when movement was lost, on the twelfth day in the first species and the ninth in the second, the two great wing muscles were already developed, and the eyes were evident upon dissection. The short period of quiescence of the heart is occupied in the histological changes of that organ, above all in the formation of an aortic region corresponding to the formation of the thorax.——The researches of M. Carlet have brought to light a previously unknown part of the sting of the honey-making Hymenoptera. The poison-bag of these insects is destitute of a muscular wall, and is thus incapable of emptying itself, but the stylets of the sting are furnished at their base with a veritable piston which moves within the length of the base of the sting, and whether the stylets move simultaneously or alternately, at each movement forces a drop of venom into the wound and produces a new afflux of liquid at the base of the sting, which is thus at once an aspirator and an injector.

ZOÖLOGY.

NEW CLASSIFICATION OF THE ROTIFERS.—Dr. C. T. Hudson, in the *Quarterly Journal of Microscopical Science* for July, attempts a re-classification of the rotifers. His paper, which is illustrated

with figures of nearly each genus, will prove very useful to American microscopists. After remarking upon and criticizing the systems of Ehrenberg, Dujardin, Leydig and Bartsch, he offers one of his own. The class Rotifera falls, he thinks, into four natural orders, according to their modes of locomotion. "There are some that swim only; others that both swim and creep like a leech; those that both swim and skip; and lastly, those that when adult are fixed; and these orders differ in the main from each other in the form and use of the foot. In each order, too, there are typical genera, round which the rest may be grouped, differing from each other in the shape of the trochal disc and the position of its ciliary wreaths, as also in the structure of the manducatory organs, and sometimes in other important points as well."

The form of the mouth-parts affords good family characteristics, while a difference in the shape and disposition of the trochal disc and its ciliary wreaths generally accompanies a difference in the manducatory organs, the two together serving "as good guides to a re-classification of the rotifers into families, which the author attempts to do.

Dr. Hudson's system is as follows:

CLASS ROTIFERA.

Order I. RHIZOTA.—Fixed forms; foot attached, transversely wrinkled, non-retractile, truncate. Family 1. *Floscullariadæ* (Floscularia, Stephanoceros); Fam. 2. *Melicertadæ* (Melicerta, Limnias, Œcistes, Cephalosiphon, Lacinularia, Megalotrocha, Conochilus).

Order II. BDELLOIDA.—That swim and creep like a leech; foot retractile, jointed, telescopic, termination furcate. Fam. 3. Philodinadæ (Philodina, Rotifer, Callidina).

Order III. PLŌIMA.—That only swim. Fam. 4. *Hydatinadæ* (Hydatina, Rhinops); Fam. 5. *Synchætadæ* (Synchæta, Polyarthra); Fam. 6. *Notommatidæ* (Notommata, Diglena, Furcularia, Scaridium, Pleurotrocha, Distemma); Fam. 7. *Triarthradæ* (Triarthra); Fam. 8. *Asplanchnadæ* (Asplanchna); Fam 9. *Brachionidæ* (Brachionus, Noteus, Anuræa, Sacculus); Fam. 10. *Pterodinadæ* (Pterodina, Pompholyx); Fam. 11. *Euchlanidæ* (Euchlanis, Salpina, Diplax, Monostyla, Colurus, Monura, Metopidia, Stephanops, Monocerca, Mastigocerca, Dinocharis).

Order IV. SCIRTOPODA.—That swim with their ciliary wreath, and skip by means of hollow limbs with internal locomotor muscles. Fam. 12. *Pedalionidæ* (Pedalion).

THE NATURE OF ECHINODERMS.—At the Paris Academy of Sciences M. Viguier reviewed the various theories respecting the nature of echinoderms. Some, as Cuvier, the elder and younger Agassiz, and Metchnikoff, considered them as simple radiate animals approaching the acalephs and ctenophores; while others, as Leuckart and Claus, believed that the worms, especially the gephyreans, were their nearest relatives. A third opinion, originated by Duvernoy and sustained by Haeckel, regarded an echinoderm as the result of the union of five vermiform organisms, and lastly M. Perrier considered it as composed of five reproduc-

tive individuals grouped around a nutritive individual. The last theory accounted for facts which could not be explained by that of Haeckel. M. Perrier communicated the details of his researches upon the anatomy of adult Comatulæ. From these researches, based upon more than two hundred sections, it appears that the organization of a Comatula is singularly like that of other echinoderms, notwithstanding the apparent wide divergence. If a sea-urchin is considered as a crinoid, the arms of which have become attached to the surface of the voluminous disk, and the mouth of which is placed at the point of insertion of the disk upon the stem, the nervous and ambulacral systems will have the same relations as in the Comatula. It is worthy of notice that at this spot the calyx of many crinoids is invaginated, and presents points not without analogy with the dental apparatus of the sea-urchins.

Destruction of Dog-fish by an isopod Crustacean.—From a communication made by Dr. Day to the Zoölogical Society of London (Feb. 5, 1884) it appears that an elongated Isopod (*Conilera cylindracea*), some of which attain a length of one and a-quarter inches, devour the soft parts of the dog-fish, muscles and entrails. On one occasion 100 dog-fish were netted, and "nearly every fish was found to have been eaten in a like manner by the lice." These "lice," as the fishermen call them, "in the summer months are found from fifteen to twenty miles from land, generally on soft and sandy bottoms. When the fishermen in foggy weather get on this bottom, they call it 'lousy ground.' Where the lice are abundant they drive away the congers and other fish. Often a shoal of bream will come and eat them up."

Are the "Chimneys" of burrowing Crayfish designed?—In *Nature*, No. 726 (June 5, 1884), Mr. Ralph S. Tarr gives an interesting account of his observations of the chimney-building crayfish (*Cambarus diogenes*). His conclusions and my own with reference to this crustacean tally except upon one point. Mr. Tarr remarks, "I do not think the chimney is a necessary part of the nest, but simply the result of digging." On the contrary, I am convinced that the crayfish *builds* his chimney or tower; that he often studies the locality with care and *builds* to suit the chosen site. My reasons for this conclusion are: That a large series observed during the present year were so placed on a steeply sloping bank of a ditch, that if the materials of which the towers were composed had been simply rejected matter derived from tunnelling, then it could have been rolled into the ditch without trouble, while in fact an artistic tower, only two inches in diameter and varying from eight to eleven inches in height, was erected; and in several instances the base of the tower was specially provided for by having the ground leveled and smoothed before the foundation masses of *puddled* clay were

put in position. Of a series of forty towers built by the *Cambarus diogenes* that I observed on the banks of a ditch, not one could have been the result of accident, as suggested by Mr. Tarr.

The towers that were found in the meadows, at a considerable distance from open water, were invariably broader at the base, and never so high as those described as found on the edge of flowing water. These open-meadow towers or chimneys, however, were all found to be composed of pellets of clay so arranged as to render it highly improbable that their positions were fortuitous. Indeed, in the majority of instances it would have been practicable to have rolled the little balls of clay to a considerable distance from the opening of the tunnel.

Perhaps there is a bearing on the question of design in tower building in the fact that often half-grown or even smaller crayfish of this species build the most elaborate structures. Some of the finest examples, *i. e.*, the most slender and tallest were the work of diminutive little fellows which certainly could have avoided a deal of labor if the chimneys or towers were not designed.

I have never seen a *Cambarus diogenes* in the act of tower-building, nor been able to determine why they tunneled at all. When this is determined I believe the towers will be found to have a close connection with the purposes of the subterranean haunts of the burrowing crayfish.—*Chas. C. Abbott.*

The Crustacea of the Talisman Expedition.—The *Talisman* brought home a fine collection of Crustacea from all depths. Swimming crabs appear to be rare at great depths, yet species of Bathynectes were found at from 450 to 950 meters off Morocco and the Cape Verde isles. Anomoura were abundant at very great depths and usually belonged to transition forms. Some of these have a very wide distribution, thus *Homola cuvierii*, previously thought to be exclusively Mediterranean, was found at the Azores and Canaries, and a species of Dicranomia described by Milne-Edwards from the Antilles, was found at the Azores. Some Galatheas were taken from the interior of the sponges of the genus Aphrocallistes. *Galathodes antonii* and *Ptychogaster formosus*, a species with its abdomen twice coiled upon itself, were dredged at 4000 meters. A considerable number of genera and species of Eryonidea were taken.

A remarkable new shrimp is *Nematocarcinus gracilipes*, with wonderfully attenuated feet and antennæ. In *Glyphus marsupialis*, another Caridean, the female has the lateral portions of the abdominal segments developed into a sort of pouch for the reception of the eggs.

Races and Hybrids among the Salmonidæ.—Dr. F. Day publishes additional facts on this subject in the Proceedings of the Zoölogical Society of London for 1884, p. 17. His previous observations, published in 1882, tended to show that the number

of species existing in Great Britain had been unduly multiplied by local races or varieties which were considered as species. Dr. Day first describes a hybrid between *Salmo salar* and *S. levenensis*, the Loch Leven trout. Here it may be said that he has raised several parrs "with comparatively large ova, which were of a deep reddish color, thus almost disposing of the statement that 'no parr has ever been found with mature ova' [Gunther's Introduction to the study of Fish, p. 639]. Certainly the ova were not mature, but would have been had the fish not met with an untimely end while the parr-marks were present, and so likewise were the silvery scales of the smolt. And as I shall show, we found at the end of November other females with ova, in all of which the parr-marks were visible."

His observations also "conclusively show that the females, without descending to the sea, may develop eggs in fresh water. And though we know that in the case of rivers in which their access to the sea has been cut off, or their migrating to the ocean prevented from any cause, these fish have usually disappeared from such streams, still we are aware that land-locked salmon are found in various parts of the globe."

On Nov. 15, 1882, 8000 ova were taken from an American charr (*Salmo fontinalis*) which were fertilized with milt from a Loch Leven trout; many of the young were more or less and variously deformed. "It is interesting to observe that about one in six of the eggs of the Loch Leven trout impregnated by the American charr failed to hatch, but double that number, or one in three, of the American charr eggs impregnated from Loch Leven trout milt. The same reason which appears to militate against trout-eggs being impregnated by salmon-milt probably is the cause, *i. e.*, the size of the spermatozoa. Thus the comparatively large Loch Leven trout-eggs were fertilized from the milt of the charr; but when the converse was tried the success was much less. As the American charr-eggs are much smaller than those of the Loch Leven trout, it is reasonable to suppose the spermatozoa are also smaller, and consequently were readily absorbed; but when it was attempted to fertilize the *Salmo fontinalis* by the milt of *S. levenensis* probably the large spermatazoa did not readily find entrance, thus accounting for the great proportion of unhatched ova. * * * *

"An exceeding interesting subject of investigation is whether we possess several or only one species of river trout. The foregoing descriptions of hybrids show that although neither the salmon nor Loch Leven trout possesses white edges to the dorsal and anal fins (such being usually restricted to the brook trout), hybrids between the two appear invariably to be so marked. This year's investigations at Howietown have likewise shown that such a mode of color may occur in old Loch Leven trout, especially males."

After detailing experiments in raising young from eggs of American charr fertilized by Scotch, Dr. Day finally remarks: "Considering that these fishes have shown no tendency to monstrosities, have been well formed, and grown fairly in proportion to the young of the true American charr hatched at the same time, I cannot resist thinking that it may be possible that these two fish, although so widely differing in color, may be merely varieties of one species, descendants from one common stock. This question, however, will be more appropriately discussed when we possess fish a year or two older."

ACCELERATION IN DEER ANTLERS.— Besides the white-tailed deer mentioned in my note in the July, 1884, number of the NATURALIST, I have in my collection the antler of a *Cervus macrotis* found near Carter, on the Rocky mountains, which is *abnormally* flattened, which shows no indication of having been injured, and so tends to support your position. It is doubly bifurcated. For four inches above the burr it is cylindrical and five and a-half inches in circumference. There it throws off a basal snag two inches long. Thence it commences to flatten, and at the first bifurcation, seven inches above the snag, it is six inches broad, whence the upper prong extends seven inches to its fork, where it is four inches wide. Above this the tines are seven inches long, and gradually assume the cylindrical form to their points. This description would answer for the lower branch except that it is not so wide by half an inch.

It is the largest antler I have ever seen from a mule deer, and is the only one I have ever seen showing a tendency to flatten. There is not the least indication of distortion, but it is perfectly symmetrical in all its parts.—*J. D. Caton.*

[*Note by the Editor.*—This case is paralleled by one observed by myself in a store in St. Paul, Minn., during the summer of 1883. This is a black-tailed deer which has one of its horns completely palmated as in Alces, while the other shows much less palmation. As I explained in the July NATURALIST, this is a case of the process of acceleration, which resulted in the creation of the genus Alces.—*E. D. Cope.*]

HABITS OF THE PANTHER.—I was much interested, as I presume many others were also, in the carefully written and, as I believe, generally accurate account of the cougar, or panther (*Felis concolor*), by Mr. Livingston Stone, in one of the recent numbers of the *Forest and Stream.* As any information regarding this rare and formidable animal is usually read with avidity by those at all interested in the fast disappearing denizens of our forests and mountains, I am tempted to add a few items of my own observation upon the habits and characteristics of this great cat, more especially as my experience in one or two minor points differs somewhat from the conclusions of Mr. Stone.

Seldom found very abundantly in any portion of our country, when compared with other wild animals of equal size, and still more rarely killed, unless by poison, the panther is nevertheless usually the first animal which disappears before the advance of civilization. They are extinct in most localities long before the deer or bears have suffered any serious diminution in numbers. Upon many portions of this coast, however, panthers are still frequently met with. It has always been a perplexing matter to my mind why the pioneers, many of whom were well acquainted with the animal as found in the Eastern forests, and knowing it there as the cougar or panther, should have straightway set about calling the same animal which they found here the California or mountain lion. Certainly in appearance the two panthers are so nearly alike that no one would dream, upon comparing them, of regarding them as distinct species.

As to their habits, my ignorance of those of the Eastern animal prevents me from comparing them in that particular. Only upon one point I can speak, and on that so far as my knowledge extends, and also from the assertions of many old hunters and trappers who were perfectly familiar with them. The panther of the West coast never indulges, for his own entertainment, in those fierce, cat-like screams with which his eastern brother occasionally makes the night hideous when hungry or lonely. I have heard their savage yell as far west as the Raton mountains on the Santa Fè trail, but although I have hunted and camped for weeks and months at a time all through the Sierra Nevada coast and Cascade ranges, from Washington Territory and Oregon in the north, to the Mexican line of San Diego in the south, in many parts of which the panthers were so abundant that their fresh tracks could be seen daily, I have always listened in vain there for their characteristic cry.

The more I learned of them in their native haunts the more skeptical I became in regard to their ever willingly attacking a man. I have known them on several occasions to follow persons a short distance, and I have seen wolves do the same thing, especially when I have been packing in freshly-killed meat, but I do not believe that in either case they meditated an attack. In one instance, in the Cascades near the Hood, I knew a panther to jump at a man as he lay at night in his blankets, but as soon as the man partly arose and shouted for assistance, the animal bounded into the brush and disappeared. In talking it over we all came to the conclusion that the panther had seen the man move under his blankets and had mistaken him for some less formidable antagonist, and that when the deception was revealed to him he threw up the job at once. As for those stories we read occasionally about their chasing a man on horseback for several miles, in which the writer assures his readers that he only escaped being devoured by being providentially mounted upon the fastest

horse in all that section of the country, they appear so absurd to to all hunters acquainted with the animal in question, that they are looked upon at once as extracts from "Dashing Dick of the Wild West," in the dime novel series.

That the panther will run from and tree before the smallest yelping cur that can be induced to follow his trail is true, but I am satisfied that instinct in some mysterious manner warns them of the hunter behind the dog, and that it is the latter only which they hold in fear. This I have demonstrated to my own satisfaction, and have had it corroborated by others. Upon one occasion I followed a panther that was being chased by a settler's dog in the dense hemlock and spruce forest through which the Clascanine river, in Oregon, runs, and although the plucky little cur treed him at least a dozen times, I did not succeed in obtaining the slightest glimpse of the brute, and after chasing him from early dawn until late in the afternoon, through the most terrific wilderness of almost impenetrable thickets, immense fallen trees and giant ferns, I found myself so completely used up that I was forced to relinquish the pursuit from sheer fatigue.

In this instance the panther must have paid but little attention to the dog after he treed, but put in the time listening for my approach, and as soon as that was ascertained he would jump at once to the ground, continue his flight for perhaps half a mile or more, when he would again take to a tree and the same thing would be repeated. Two or three times, where the ground was particularly favorable, I got near enough to hear him leave the tree, which he seemed to do just as readily as if there had been no dog there.

In regard to their manner of climbing, they ascend the immense trees near the mouth of the Columbia, which are frequently 300 feet high, and sixty, eighty or even a hundred feet to the first limb, precisely as a cat would climb them, and, when wounded, will sometimes go to the very top. In one instance I found in a small glade in the forest where, from the sign, it was evident that two or more of them had been gamboling, and like kittens scurrying around in the grass, and then bounding against the trunk of a tree at a point at least ten feet from the ground, they had ascended apparently on the run, tearing off great pieces of bark, and leaving claw marks a foot long on each side.

Although they may in some localities spend the day in lying upon the limb of a tree, I think they always prefer rocky ledges and caverns for that purpose, where such are accessible. In San Diego, near the Arizona line, the rugged, rocky ranges furnish admirable retreats for panthers, there usually called mountain lions; and although not so abundant, they are, I think, more frequently shot than they are further north, for reasons that will soon be explained. Like all of the cat tribe they are partial to warmth, and upon days when it is rather cold in the shade, they

frequently come out of their lairs in the middle of the day and lie upon the rocks near by to bask and drowse in the warm sun, and as the ranges there are generally very sparsely timbered, they are occasionally discovered by hunters, when the chances of getting within shot are better than under almost any other circumstances. But for all that, they are animals that are seldom shot, no matter how abundant they may be, and their disappearing so rapidly before the march of civilization is a mystery that I can only solve by the conclusion that being such a large and entirely carnivorous animal, they are immediately affected by the least thinning out of the large game, and are driven by hunger to seek places where the rifle has not begun its deadly work, unless, as they seem to have done on the McCloud river, they turn their attention to the stock of the settler.

Many of them are poisoned by the sheep and cattle men of the southern counties, when their visits to the flocks and herds become too frequent. I have often seen their hides nailed to the walls of the lonely cabins of the stockmen there, and, upon inquiry, have found that they were poisoned in at least three cases out of four.

I entirely agree with Mr. Stone in the belief that a panther would be no match for a grizzly. It is quite possible that their superior agility might sometimes make them more than a match for a black bear, but I can only conceive of their being able to kill a grizzly by fastening upon him in a position where the bear was unable to inflict any injury upon them, as a single, well-directed blow from the paw of a full-grown grizzly will crush in the ribs of an ox, and would, I fancy, leave but little fight in any panther.

With a single incident to illustrate the idea that it is the hunter and not the dog the panther fears, I will close this already lengthy article. In the summer of 1868 I was in Port Gamble, on Puget sound. A trail leading to Port Madison, eight or ten miles distant, was the only land route open in any direction, and that ran through an unbroken forest the entire distance. One of the workmen at the saw-mill at Gamble was returning along the trail from Madison, one afternoon, having with him a favorite little dog, who was trotting along a few yards in advance, when a panther bounded suddenly from the brush and, snatching up the dog, disappeared with the quickness of thought on the other side of the way. The man stated that it was so quickly done that he seemed to take the dog without stopping in a flying leap across the trail.—*Forked Deer, in Forest and Stream.*

Zoological Notes.—*Fishes.*—In Switzerland, according to M. V. Fatio, the minnow reaches an altitude of 2400 meters, and the miller's thumb one of 2200 meters. The perch stops at 2000 meters, and no others pass above 800 meters, although the carp,

tench, rudd, roach and chub have been successfully introduced into waters at from 1000 to 1700 meters in altitude. *Gobius fluviatilis* has ascended the Po to the confines of Switzerland, and *Blennius cognata* occurs in abundance in Lake Maggiore and in the Lake of Bourget in Savoy.

Mammals.—MM. Pouchet and Beauregard have been led by the examination of a portion of the "case" containing the spermaceti of the cachalot, to emit the supposition that the "roots" of this case may be the analogue (homologue?) of the posterior region of the right nasal fossa, while the reservoirs situated anteriorly may represent the smooth part of the same nasal cavity, separated from the spouting sacs or opening into them only by an extremely reduced orifice. The walls of the part of the case examined consisted of mucous membrane fifteen millimeters thick, with the surface raised into convolutions separated by fissures in such a way as to recall the surface of the brain. The secretion is thus non-glandular and approaches, physiologically, the secretion of wax by the bee. The structure of the case of the cachalot does not recall any organ present among mammals.

PHYSIOLOGY.[1]

THE PHYSIOLOGY OF RUMINATION. — As is well known, the stomach of a ruminant animal is a complex organ consisting of four distinct chambers. Of these the last, that opening directly into the intestine, corresponds functionally to the single stomach of other vertebrates, the other chambers of the herbivorous stomach probably only being concerned in the preparation of food preliminary to digestion. The feeding of ruminants is characterized by the fact that the food when first swallowed passes only as far as the first and largest division of the stomach, the paunch, where enormous quantities may be laid up. When the animal has ceased feeding it seeks a position of rest and then begins a regurgitation by piecemeal of food from the paunch into the mouth, where it is thoroughly masticated, "chewing the cud," after which it is swallowed into the "fourth stomach" for final digestion. It is this process of rumination which Professor Luchsinger has recently studied in the goat.

Attention is called to the fact that the act of rumination is interrupted if the animal is disturbed in the slightest degree. The goats experimented on were narcotized with morphia, which numbs painful sensations but interferes little with reflex action. After appropriate operations, the author was enabled to assure himself that pressure with the hand upon the wall of the paunch brought about in perfectly normal manner the act of rumination, there was first a movement of the vocal cords tending to close the glottis, then the diaphragm contracted so as to press upon

[1] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

the upper surface of the stomach, and at the same time the abdominal walls contracted energetically; a morsel of food was thus thrown up rapidly into the mouth, any excess of water in it being pressed out and swallowed; then began a long series of cud chewing movements, at the beginning of which occurred a copious flow of saliva into the mouth; finally, with a swallowing movement the mouth was emptied and the masticated morsel sent back for its complete digestion. The amount of food regurgitated was determined by the sphincter muscles at the cardiac opening of the paunch, these muscles relaxing at the beginning of the act but closing finally again when a small amount of food had been forced out. The whole series of movements was readily brought about by electrical stimulation of the wall of the paunch, or when this was mechanically excited by distension with warm water or by pressure with the hand. Strange to say the flow of saliva and the chewing movements followed in regular order expulsion of food from the paunch, though the morsel was not, in some cases allowed to enter the mouth but was expelled lower down from the divided œsophagus. This artificially excited act of rumination could only be provoked when the pneumogastric nerves were intact.

Luchsinger concludes that rumination is a complex reflex action, the stimulus to which is the distension of the walls of the paunch by the accumulated food matter, the amount of pressure upon the wall being also, no doubt, regulated by the motor nerves of the stomach. The afferent nerves concerned in the reflex are probably the vagi, and these call into coördinated action a number of correlated nerve centers governing salivation, mastication and movements of the vocal and swallowing apparatus.—*Pfluger's arch., 1884, Bd. 34, S. 293.*

Circulation of Blood Corpuscles.—Dr. G. J. Hamilton has made an examination of the physical conditions which affect the movement of solid bodies suspended in a circulating fluid with reference to the analogous case of the blood corpuscles in the living body, and his results are full of suggestiveness in the explanation of many obscure phenomena of pathology. The blood corpuscles are solid bodies suspended in a liquid plasma; the red corpuscles outnumber the white about 300 or 400 to one. It was the aim of the author to determine the relation between the specific gravity of the corpuscles (with respect to that of the plasma) and the circulation of the blood. A stream of water was allowed to flow through a horizontal tube several feet in length, and little balls or disks of wax and other substances of various sizes and specific gravities were dropped into the current and carried along by it. In this simple scheme of the circulation it was found that the balls or disks when specifically lighter or heavier than the fluid were carried along the sides of the tube, in the former case

against the upper and in the latter against the lower side. Friction on the tube wall retarded the motion and gave a rotating movement to the solid bodies which tended to accumulate and clog the bore of the tube.

When the balls were of the same specific gravity as water they were swept along the middle of the tube and remained always in the "axial" or swiftest moving central current without touching the sides. In the normal circulation of the frog it can be shown that the white corpuscles pass along the upper wall of the blood vessel with a rotating motion. In order to make this observation the vessel observed must lie in a horizontal position while the web or sheet of tissue holding it is in a vertical plane. When the blood-vessel twists so that what was once the upper side becomes the under, the white corpuscle, carried on by the current, gradually crosses the stream and reaches the new top wall. These facts are easily explained when it is considered that the white corpuscles are specifically lighter than the blood plasma. The red blood corpuscles move in a crowd, without rotation, away from the vessel wall, in the so-called axial current, which is more marked the more rapid the circulation.

The red corpuscles are specifically scarcely heavier than the plasma, while the white are considerably lighter. The author points out the evident conclusion from his experiments, that the relation between the specific gravities of red corpuscles and plasma must remain during health in very fine adjustment. For were the red corpuscles to become decidedly either specifically lighter or heavier than the plasma, they must crowd against the vessel walls and the frictional resistance thus offered to the circulation might readily exceed the power of the heart to overcome.

It does not seem improbable that a disturbance of the specific gravity of the blood plasma in extensive albuminuria is the direct cause of the inflammations of different kinds, such as pleurisy, pneumonia, &c., to which there is a great tendency in that disorder. The tendency to hypertrophy in the left ventricle of the heart, and to general dropsy, may be explained in the same way.

In Asiatic cholera the water is rapidly drained from the blood, and the speedy collapse may have its solution in the clogging of the blood-vessels with corpuscles that are crowded against their walls.—*Journ. of Physiology, Vol.* v, *p. 66, 1884.*

PSYCHOLOGY.

Emotional Faculties of Animals.—It will be observed, on turning to the diagram, that I attribute to animals the following emotions, which I name in the probable order of their historical development: Surprise, fear, sexual and parental affection, social feelings, pugnacity, industry, curiosity, jealousy, anger, play, affection, sympathy, emulation, pride, resentment, æsthetic love of ornament, terror, grief, hate, cruelty, benevolence, revenge, rage,

shame, remorse, deceit, ludicrous. This list, which leaves many of the human emotions without mention, exhausts all the emotions of which I have found any evidence in the psychology of animals. Before presenting this evidence in detail, perhaps it will not be thought superfluous again to insist that in attributing this and that emotion to such and such an animal, we can depend only upon inference drawn from actions, and that this inference necessarily becomes of less and less validity as we pass through the animal kingdom to organisms less and less like our own; so that, for instance, when we get as low down as the insects, I think the most we can confidently assert is, that the known facts of human psychology furnish the best available pattern of the probable facts of insect psychology. Still, as the known facts of human psychology furnish the best available pattern, we must here, while treating of the emotional faculties, follow the same method which we have hitherto followed while treating of the intellectual faculties, viz., while having full regard to the progressive weakening of the analogy from human to brute psychology as we recede through the animal kingdom downwards from man, nevertheless using the analogy, as far as it goes, as the only instrument of analysis that we possess.

I shall now proceed, as briefly as possible, to render the evidence which has induced me to ascribe each of the above named emotions to animals, and remembering that I have in each case written the emotion upon the diagram at the level of mental evolution where I have found the earliest evidence of its occurrence, it follows that in the majority of cases the emotion is present in the higher levels of mental evolution in a more highly developed form.

It will be observed that in the diagram I represent the emotions, as a class, to take their origin from the growing structure of mind at the same level as that at which the faculty of perception takes its origin. I do this because I think that as soon as an animal or a young child is able to perceive its sensations, it must be able to perceive pleasures and pains; hence, when the antecedents of a painful perception recur in consciousness, the animal or child must anticipate the recurrence of that perception—must suffer an ideal representation of the pains, and such suffering is fear. And that, as a matter of fact, fear of this low or vague order is manifested at about the second or third week of infancy, is the general opinion of those who have most carefully observed the development of infant psychology. To specify the class in the animal kingdom where a true emotion of fear arises is clearly a more difficult matter, and indeed it is impossible to do so in the absence of any definite knowledge as to the class in which perception first arises. But while, as previously explained, I am not able to say whether or not the Cœlenterata, and still less the Echinodermata, are able to perceive their sensations, I think the

evidence becomes very strong in the case of insect larvæ and worms. And that both the one and the other manifest striking symptoms of alarm in the presence of danger may be easily shown.

With reference to young children, Preyer is of opinion that the earliest emotion is one of surprise or astonishment upon perceiving any change or strikingly novel feature in the environment. In deference to his opinion, therefore, I have placed surprise upon the same level of emotional development as fear, but of course in both cases this level is so low that it is but the germs of such emotions that are here supposed to be present.

This earliest stage of emotional development (18) I have made to correspond with "emotions preservative of self." The next stage (19) I made to coincide with the origin of "emotions preservative of species;" and of these the first to appear are the sexual. In the animal kingdom—or rather let us say in the psychological scale—these emotions are first unequivocally exhibited by the Mollusca, which on this account, as well as for the reasons given while treating of the association of ideas, I have made to fill the corresponding level on the other side of the diagram.

The next level (20) is occupied by parental affection, social feelings, pugnacity, emotions conducing to sexual selection, industry and curiosity. The level, therefore, corresponds with the origin of the branch marked social emotions in the central psychological tree, and with the earliest recognition of offspring on the side of the intellectual faculties. The animals which first satisfy all these conditions are the insects and spiders. For here, even if we exclude the Hymenoptera, we have evidence of parental affection in the care which spiders, earwigs and sundry other insects take of their eggs and broods. Again, numberless species of insects are highly social in their habits; others are highly pugnacious; some are conspicuously industrious; most flying insects display curiosity; and, according to Mr. Darwin's elaborate inquiries, it is also in this class that we find the earliest evidence of sexual selection.

Coming now to level 21, I have assigned to it the first appearance of the emotions of jealousy, anger and play, which unquestionably occur in fish. On level 23 I have placed the dawn of affection other than sexual, in view of the evidence of the emotional attachment of a python which was exhibited toward those who had kept it as a pet.

On level 24 I have placed the dawn of sympathy, seeing that this emotion seems to be unquestionably, though very fitfully, displayed by the Hymenoptera, which for other reasons I have felt obliged to assign to this comparatively high stage of psychological development.

On the next level (25) I have given emulation, pride, resentment, æsthetic love of ornament, and terror as distinguished from

fear. All these emotions, so far as I have been able to ascertain, first occur in birds; and in this class some of the emotions which I have already named as occurring in lower classes are much more highly developed.

Next we arrive at grief, hate, cruelty and benevolence, as first displayed in some of the more intelligent of the Mammalia. Grief is shown by pining, even to death, upon the removal of a favorite master or companion; hate by persistent resentment; cruelty by a cat's treatment of a mouse; and benevolence by the following instances which I have met with since the publication of Animal Intelligence. Writing of a domestic cat, Mr. Oswald Fitch says, that it "was observed to take out some fish bones from the house to the garden and, being followed, was seen to have placed them in front of a miserably thin and evidently hungry strange cat who was devouring them; not satisfied with that our cat returned, procured a fresh supply, and repeated its charitable offer, which was apparently as gratefully accepted. This act of benevolence over, our cat returned to its customary dining place, the scullery, and ate its own dinner of the remainder of the bones." An almost precisely similar case has been independently communicated to me by Dr. Allen Thomson, F.R.S. The only difference was, that Dr. Thomson's cat drew the attention of the cook to the famishing stranger outside by pulling her dress and leading her to the place; when the cook supplied the hungry cat with some food, the other one paraded round and round while the meal was being discussed, purring loudly. One further instance of the display of benevolent feeling by a cat will suffice. Mr. H. A. Macpherson writes me that in 1876 he had an old male cat and a kitten aged a few months. The cat, who had long been a favorite, was jealous of the kitten and "showed considerable aversion to it." One day the floor of a room in the basement of the house was partly taken up in order to repair some pipes. The day after the boards had been replaced the cat "entered the kitchen (he lived almost wholly on the drawing-room floor above), rubbed against the cook and mewed without ceasing until he had engaged her attention. He then, by running to and fro, drew her to the room in which the work had taken place. The servant was puzzled until she heard a faint mew from beneath her feet. On the boards being lifted the kitten emerged safe and sound, though half starved. The cat watched the proceeding with the greatest interest until the kitten was released; but on ascertaining that it was safe he at once left the room without evincing any pleasure at its return. Nor did he subsequently become really friendly with it."

On the next level I have placed revenge as distinguished from resentment, and rage as distinguished from anger. In Animal Intelligence I give some cases of apparent vindictiveness occurring in birds; but as the exact nature of the emotions in these

cases appears to me somewhat doubtful, I here disregard them, and place revenge on the psychological level which is occupied by the elephant and monkeys, in which animals this passion is very conspicuous. The same remarks apply to rage as distinguished from the less violent display of hostile feeling which is suitably expressed by the term anger.

Lastly, at level 28 we arrive at the highest products of emotional development which are manifested in animal psychology, and therefore at the highest of those products with which the present treatise is concerned. These are shame, remorse, deceit and the emotion of the ludicrous. For instances of the display of these emotions by dogs and apes, I need merely again to refer to Animal Intelligence.

In this brief sketch of the emotional faculties as they occur in the animal kingdom, my aim has been to give a generic rather than a specific representation. I have therefore omitted all details of the emotional character of this or that particular animal, as well as the narration of particular instances of the display of emotions.—*Romanes' Mental Evolution.*

THE MEASUREMENT OF HUMAN FACULTY.—Mr. F. Galton, M.A., F.R.S., delivered, reports the *English Mechanic*, the Rede lecture at Cambridge, last spring, taking for his subject "The measurement of human faculty." After briefly describing the art of measuring human faculties as the "dawn of a new and interesting science," Mr. Galton said that his new evidence, which he had taken some pains to obtain, showed that the actions of men are "governed by cause and effect;" but if the conduct of man is the result of some external influence, then such knowledge as he has obtained is of little service. Mr. Galton concluded by suggesting that a laboratory should be opened at Cambridge to investigate this "new science." An anthropometrical laboratory will be opened at the Health Exhibition by Mr. Galton.

ANTHROPOLOGY.[1]

THE ANNALS OF CHIMALPAHIN.—Domingo Francisco de Saint Anton de Chimalpahin, born in 1579, was a Mexican. He was descended from the kings of the State of Tzacualtitlan-Tenanco-Amaquecan, whose first sovereign reigned 1269–1338. Chimalpahin was versed in astronomy, history, geography, and in the study of the antiquities of his country. He composed in Nahuatl, by the aid of our alphabet, eight relations, or annals. They form part of the collection of Boturini. They were found by Aubin and their publication commenced. M. Rémi Siméon was associated with Aubin and copied a part of the annals. They are chronological tables, containing, besides the genealogies of kings, princes, princesses and lords, mention of the principal political

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

events of his country. In the second relation the author commences the history of the Chichimecs at the time when they debarked on the Gulf of California.—[Le Muséon, III, 334.]

THE BOARD OF INDIAN COMMISSIONERS.—Although the especial function of this board is not anthropological, the thoughtful student of the natural history of our race will find much food in their report for serious thought. We all believe in the continuity of history. As we look at the fragmentary story of the past, we wonder how those heterogeneous events could ever have formed part of a single mosaic. In the report of 1883, pp. 8–33, is a picture of a struggle going on in the Creek nation between the party of progress and the party that sigh for the flesh pots of Egypt.

"Tantæ molis erat Romanam condere gentem."

THE HEALTH REPORT OF WASHINGTON.—The report of the health officer of Washington is doubtless a parallel with the similar publications in most of our well regulated cities. The growing complexity of our civilization is well exhibited by the measures taken to defend human life and happiness against the perils arising out of our greatest comforts. A report of this kind is also a good barometer to indicate whether we are advancing or retreating in social strength. For instance, when the health officer informs us that the increase of calls on the public dispensary is greater than the increase of population, we at once see that public morals are declining. When he informs us that the colored applicants are twice in number those that are white, while the white population doubles the colored, we know that pauperism is four times as great among the colored people. The most accurate information comes from the mortality tables, which foot up as follows for eight years:

	Population.			Deaths.			Death-rates.		
	White.	Colored	Total.	Whi.	Col.	Tot.	Whi.	Col.	Total.
1876	106,741	50,859	157,600	2090	2072	4162	19.58	40.74	26.35
1877	109,505	52,870	162,375	2190	2014	4204	20.00	37.39	25.89
1878	112,340	54,960	167,300	2167	2068	4235	19.29	37.63	25.32
1879	115,247	57,053	172,300	2196	2113	4309	19.06	37.03	25.00
1880	118,236	59,402	177,638	2085	2121	4207	17.63	35.71	23.68
1881	121,300	61,760	183,060	2205	1931	4136	18.18	31.27	22.59
1882	124,441	64,212	188,653	2353	2218	4571	18.91	34.54	24.23
1883	126,300	65,680	191,980	2270	2016	4286	17.98	30.68	22.33
Mean annual rate							18.83	35.62	24.42

It is impossible to compare this with births, because while the death list is accurate, the health officer cannot get the correct birth list. In the foregoing table it will be noticed that the white rate is fluctuating, but decreasing; the colored death rate has steadily diminished, showing a decided improvement in prosperity and hygiene. Of 3116 births reported, 851 were white

males; 833 white females; 715 colored males; 715 colored females. Of 353 bastards reported, 300 were colored. Of 1684 white births 1004 were certified by physicians, while of 1431 colored births only 295 are returned by physicians, and of this number 126 are from the hospitals.

THE INDIAN OFFICE REPORT.—Among the various ways of viewing the social transformations of any people, one that is easily taken and that will lead to good results, is the comparison of tribes, at various epochs, as to their wants and their demands upon their conquerors. In the treaty with the Six Nations, dated January 21, 1795, the United States guarantees $3000 in addition to $1500 allowed April 3, 1792, for clothing, domestic animals, implements of husbandry and useful artificers. The series of artificers in nearly all the tribes has been as follows: 1. Gunsmiths, to help the savages to perform old functions with new tools; 2. Blacksmiths, who taught rude husbandry and paved the way for, 3. The miller and the schoolmaster. The missionaries, both Catholic and Protestant, taught the Indians to read and to repeat service both in English and Indian from the first. From the beginning of the century differentiation of functions and multiplication of wants have increased until the present commissioner's report of crops and other products of Indian labor; of horses, mules, cattle, swine, sheep and domestic fowls; of goods consumed, such as bacon, beef, vegetables, grain, coffee (365,000 lbs.), flour and salt (1,000,000 lbs.); of fabrics, such as blankets, clothing, household fabrics (1985 mosquito bars), shoes, hats and notions; of groceries (25,000 lbs. baking powder and 149,690 lbs. of soap are included); and of crockery, furniture, harness and agricultural implements occupies 110 pages. A very instructive paper on sociology could be made out of these figures. The report of education is most encouraging:

School population exclusive of civilized tribes		35,883
Number who can be accommodated in boarding schools		5,182
" " " " day "		6,032
Boarding schools		117
Night "		2
Pupils in school one month or more	Boarding 5139	
	Day 5102	10,241
Teachers and employés		683
Cost of schools, Govt. $361,185, Religious societies $70,588, New York $17,512, employés $160		$449,445
Indians who can read		14,399
School children in civilized tribes		11,450
Sittings: boarding schools 1269, day schools 6330		7,599
Boarding schools		14
Day schools		199
Boarding pupils		1,284
Day pupils		3,700
Cost to Five Nations $162,030, to religious societies $13,578		$175,608
Can read in the tribes		32,050

There is but one suggestion to make with reference to the

commissioner's reports. Much of the space that is filled with mere gossip and unpractical advice from agents might be the repository of the most useful ethnological information.

THE INDIAN MUSEUM AT CALCUTTA.—Dr. John Anderson has issued Part II of the Catalogue and hand-book of the archæological collections of the Indian Museum. Gupta and inscription galleries, Buddhist, Jain, Brahmanical and Muhammadan, sculptures; metal weapons, objects from tumuli, etc. Calcutta, printed by order of the trustees, 1883. The volume contains 521 pages, and is much more than a list of articles. Some one has said that a well ordered museum is a collection of carefully prepared labels with specimens attached. Dr. Wilson has not only brought to his work a great deal of learning, but has also called to his aid several distinguished specialists. It is impossible to single out any part of the volume for an example, where all is so well done.

A NEW JOURNAL.—The following is the title of a new journal of comparative philology: *Internationale Zeitschrift für allgemeine Sprachwissenschaft*, unter mitwirkung der Herren [L. Adam and many others] herausgegeben von F. Techmer, docenten der allgemeinen Sprachwissenschaft an der Universitat Leipzig. 1 Band, 1 Heft. Leipzig, Joh. Ambr. Barth, 1884.

The following papers appeared in the first number:

Introduction to general philology. By A. F. Pott. Philosophical side; Origin of language, general grammer; physical side; psychical side; natural history—psychical side; classification of languages, pp. 1–68.

Scientific analysis and synthesis of audible speech. By F. Techmer. Speech from without as it approaches us; acoustic, analysis and synthesis; Speech from within outward: Anatomical and physiological genesis of speech, the windpipe, glottis, nose, palate, tongue, mouth. The classification of vowel and consonant sounds; the syllable, symphony, pp. 69–170.

The articles following are short notices and reproductions. The papers by Pott and Techmer are both thoroughly done. Since Max Müller began to publish rude maps of the mouth in his discussions on language, there has been great improvement in the correlating of physiology and glossology. But F. Techmer has given us the most thorough discussion and illustration of this subject. One hardly knows, when he is looking at the illustrations, whether he has in hand a treatise on language or a text book on anatomy.

ANTHROPOLOGY IN FRANCE.—With the current year *Materiaux* commences Vol. I, 3d series. The first two numbers present the following valuable memoirs:

Study of some Hallstattian necropoles in Austria and in Italy. By Ernest Chantre. [pp. 1–27, 31 figures of pottery and bronze objects. Quite a number of new forms are presented.]

History of prehistoric anthropology. Cuvier and the antiquity of man. By Emile Cartailhac. [pp. 27–34. This is a defence of Cuvier against Mortillet's charge of having opposed the theory of the antiquity of man.]

The Ethnogeny of Western Europe. By Dr. Hamy. [pp. 35–48. The paper is the opening discourse at the Museum of Paris. The subjects to be considered are: 1. Natural classification; 2. Linguistic classification; 3. Chronologic classification. In the latter will be considered prehistoric races, contemporaneous with extinct animals; the neolithic peoples, builders of the dolmens, the Iberians, the Ligurians, the Celts, the Romans, Germans, Franks, Saxons and Normans. Incidentally the Slavs, Fins, Hungarians and Turks will receive attention.]

M. Martinet reviews several works of importance on the archæology of South America. (pp. 49–57.)

Discovery of prehistoric quarries for silex. By Marcellin Boule. (pp. 65–75.)

The Société d'Anthropologie de Paris has elected, for 1884, M. Hamy, president, and Dr. Paul Topinard, general secretary.

Revue Scientifique publishes a paper, by Lombroso, upon anthropology and criminality (No. 10, pp. 303–308), in which he reviews the works of Lacassagne, Ferri, Manouvrier, Heger and Dallemagne, Orchanski and many others.

FURTHER DISCOVERIES OF PERFORATED CRANIA IN MICHIGAN.—During the last two years excavations in various mounds along the Detroit river, in the vicinity of the city of Detroit, have brought to light a number of instances, in addition to those which I have already noted and to which I first called attention many years ago, of the peculiar burial custom of perforating the skull of the deceased. While this additional material strongly corroborates the deductions based upon my former discoveries, notwithstanding the most careful investigation, I am unable to contribute any new information throwing light on the special significance of the custom. As in former cases not all the skulls taken from a single depository were distinguished by this peculiar mark. Without a single exception in these latter specimens, as in all others which I have examined where perforated, the opening is exactly centered in the top of the skull. This tends to confirm my early assumption that whatever may have been the primary object of the custom, whether it points to a religious observance, or is indicative of caste simply—a mark of honor, &c., it included, in all probability, the suspension of the cranium. The nicety with which the position of the aperture is established is remarkable, it never being in the least to one side of the center. In the few instances where three holes were found, the extra two were placed near the central perforation, and at equal distances on each side of it, thus preserving the equilibrium.

In these last examples the perforation is of the smaller size, in every case being less than half an inch in diameter. The crania are of the orthocephalic type, and where the other bones were recovered, they were found to present most of the peculiarities which I have recorded as pertaining in similar instances to my former discoveries, extremely flattened tibiæ being the most decided abnormality observed. The platycnemism is posterior.

In a communication received by me in July, 1876, from the

late M. Paul Broca, whose recent death, shortly after his election as a life senator of France, is so great a loss to science and especially to anthropology, the illustrious savant coincides with my opinion, long previously expressed, as to the Neolithic trepanning found in the caves of France having no connection with the cranial perforation observed by me in Michigan. A translation of his running comparison of the two sorts of perforations, elicited by the publication of my discoveries, having made some slight changes and additions, rendered necessary by my fuller information and the acquisition of new material, I here append for the benefit of those who may not have access to my papers on the subject:

Of the Neolithic perforations of France.—1. Some are surgical, others were made after death.

2. Both sexes and all ages, including infants and children, were subjects.

3. They are from three to five centimeters in length on the head of adults, with very oblique and cicatrized edges.

4. The position is variable.

5. The posthumous were made by the aid of an instrument moved like a saw, detaching the fragment, &c.

6. Object of the posthumous: To secure the fragments, which were used for amulets.

Of the perforations in the ancient crania of Michigan.—1. All were made after death.

2. They are confined to adult subjects, and probably the male sex.

3. They are generally from about one to two centimeters[1] in diameter, with oblique but not cicatrized edges.

4. The position is constant—centrally placed at the top of the head, and always on the sagittal suture, or at its juncture with the coronal suture.

5. They were made probably with an instrument turning principally semicircularly.

6. Object unknown (perhaps the extraction of the brain, perhaps the suspension of the head).

There is no evidence that the parts removed were preserved, or that even they were cut out entire.

It is remarkable that, so far, the discovery of the American perforations has been confined, perhaps with a single exception, to the mounds in Michigan. It seems probable, however, tha proper researches would reveal similar relics from mounds on the Canada shores of the Detroit river and Lake Huron.

Those who may be interested in a more extended discussion of this interesting custom, I refer to the following mentioned of my

[1] The smallest of the perforations which I have as yet seen is about one-third of an inch in diameter; the largest, of elliptical form, has the major diameter eight-tenths of an inch.—*H. G.*

papers which treat of the subject: "Certain characteristics pertaining to ancient man in Michigan," Smithsonian Report for 1875; "The ancient men of the Great Lakes," read before the Detroit meeting of the American Association, August, 1875; "Additional facts concerning artificial perforation of the cranium," &c., Proceedings of the American Association, August, 1875.

In a future paper I hope to be able to give some facts of more or less interest with reference to the bones, &c., found in connection with the crania last discovered.—*Henry Gillman, Detroit, Michigan.*

THE ARUBA LANGUAGE AND THE PAPIAMENTO JARGON.—*The Aruba language.*—Aruba is the westernmost isle of the group of islands called the "Lesser Antilles," which extends along the northern coast of South America at a short distance from the mainland. It lies north of the Peninsula of Paraguana, Venezuela, and northeast of the entrance to the Gulf of Maracaibo; it belongs to the dominion of the Dutch in the West Indies, which extends over the following islands: Aruba (preferable to the orthography Oruba), Curaçao, Curaçilla at the south-eastern cape of Curaçao, Bonaire or Buen Aire, and the two Aves or Bird islands. Curaçao is the largest island of the archipelago, and consists of a barren rock almost devoid of vegetation; the capital of the Dutch colony, Wilhelmstadt, is built on its southwestern shore. In former times the thrifty inhabitants accumulated wealth as the mediators of a lively smuggling trade between the Spanish and the other colonies of the West Indies. Salt is now the staple produce of Curaçao with its 22,000 inhabitants; as to its size, it is nearly three times larger than Aruba, which has 200 square kilometers and 5670 inhabitants.

The explorer Alphonse L. Pinart, through whose kindness some linguistic material was obtained, visited the Curaçao group in the summer of 1882. Although the natives of Aruba have since A. D. 1800 abandoned their paternal language for the Papiamento jargon, their exterior is still of a pure Indian type. The Aruban language was probably the same as that of Curaçao and related to the vernacular of the peninsula of Paraguana. From natives far advanced in age, Pinart succeeded in obtaining a few terms of the Aruban language and of local nomenclature, also six sorcerers' formulas, and from the Papiamento, as spoken at present, he secured a limited number of plant and animal names evidently pertaining to the extinct Indian dialect, the number of which may be easily increased by future travelers.

An old Aruba Indian, recently deceased, witnessed at the former Indian encampment at Saboneta the inhumation of a native female in one of the large conical ollas, her body being doubled up within the vase and the head protruding through the orifice. A smaller urn was then placed upon the head, bottom up, and the whole covered with earth. Several Aruban grottos and rock

shelters yielded inscriptions and pictographs to the explorer, who considers their style as related to the pictography of the Orinoco and Apure countries. Fragments of pottery, hatchets made of shells and stones are profusely scattered around the ancient encampments of the native Arubans.

The name of *Curaçao* island seems to be the Tupi word coaracy′, curassé, *sun*, in Guarani, quaraçí; *Aruba* resembles the name of a shrub which is called in French Guyana *arube*. Nicolas Fort y Roldan, in his "Cuba *indigena*" (Madrid, 1881), p. 125, gives *arabo* as the name of a plant as heard on one of the Great Antilles.

The Papiamento.—On account of the peculiar selection and association of their ingredients, and the grammatic changes which the terms are undergoing, the jargons or medley languages are now being studied by linguists with the interest they deserve. The best known jargons of America are the conversational Tupi or "lingoa geral," the various negro jargons of Guyana, of the West Indies and of Louisiana, the Chinook jargon, etc.; in the early stages of their formation English, Turkish and Neopersian were jargons also. The main ingredient of Papiamento, which is spoken upon Aruba, Curaçao and the rest of this island group, is the Spanish language; then comes Dutch, the language of the Netherlandish rulers, and least in frequency are the words of Indian origin.

The character of this medley speech will best appear from a Conversational Guide, which has been published at Curaçao, 1876.—*A. S. Gatschet.*

MICROSCOPY AND HISTOLOGY.[1]

MYRTILLUS, A NEW DYE FOR ANIMAL AND VEGETABLE TISSUES.—Dr. M. Lavdowsky[2] recommends the juice of fresh huckleberries, *Vaccinium* (Gaylussacia Gray) *myrtilus*, as an excellent staining medium, especially for the caryokinetic figures and the cellulose walls of plant cells.

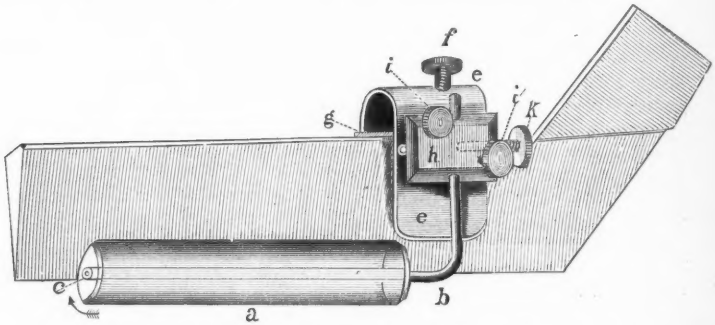
Preparation.—The newly picked berries should be washed in water, then the juice expressed and mixed with twice its volume of distilled water containing a few grams of ninety per cent alcohol. The mixture may next be boiled for a short time, then filtered while it is still warm. The fluid thus obtained is deep red and slightly acid, and may be kept in well corked bottles for a long time, if not left in too warm places. The fluid becomes somewhat thick on cooling, and may therefore be diluted with 2–3 times its volume of distilled water at the time of using.

Two different colors are produced by this fluid: 1. *A red color* is produced by the action of the fluid on fresh objects, *and on objects hardened in chromic acid or other chromic solutions.* The

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.
[2] *Arch. f. Mik. Anat.*, XXIII, pp 506–508.

best staining is said to be obtained from chromic acid preparations. 2. *A lilac color*—more durable than the red—may be obtained in the following manner: Place three watch-glasses on a white ground, fill one with the myrtillus fluid, the second with a one per cent solution of acetate of lead, and the third with distilled water. Place the object in the dye for one or two minutes, wash in the distilled water, then leave in the solution of acetate of lead until the lilac color becomes pronounced; finally wash and mount in glycerine or, after treatment with alcohol, in balsam. In case glycerine be used, a little acetate of lead should be mixed with it.

A NEW SECTION-FLATTENER.—Dr. F. Decker[1] has invented a section-flattener which presents an important improvement on those hitherto described in this journal. The flattener is a cylindrical glass roller (*a*) which rotates on a brass rod (*b*).



The diameter of the rod is $2^{mm.}$ slightly less than the lumen of the roller, so that the latter rotates easily and evenly.

A steel plate (*e*) bent so that the two arms clasp the blade firmly, forms a carrier for the roller and its shaft. The carrier is slipped on at the free end of the blade, and the pressure of its arms strengthened by means of the screw (*f*), the inner end of which bears against a narrow strip of steel (*g*). To the upper arm of the carrier a brass block (*h*) is attached by means of a hinge which runs lengthwise along the middle of the under side of the block. The short arm of the brass rod (*b*) passes through the middle of the block in a horizontal direction, and is fixed in any position by means of the screw (*k*). The distance of the glass roller from the edge of the knife is regulated by the screws *i* and *i'*. If one of these screws is raised and the other lowered one half of the block (*h*) will be raised and the other half lowered, and the distance between the roller and the blade correspondingly altered. The length of the glass cylinder (*a*) is $5^{cm.}$ its diameter should vary according to the size of the object to be

[1] Ein neuer Schnittstrecker. *Arch. f. Mik. Anat.*, XXIII, pp. 537–543, 1884.

sectioned. Three cylinders, measuring 4, 6 and 9^{mm} in diameter, will be found sufficient for all ordinary purposes.

The apparatus above described can be adjusted to knives of different microtomes. It may be obtained from Gustav Stöber in Würzburg.

THE DISTOMIAN BROOD-SAC OR SPOROCYST.—Our knowledge of the life-cycle of the digenic trematodes has become nearly complete through the researches of Leuckart, Thomas, Schauinsland and Biehringer. Schauinsland was the first to trace the development of the trematode embryo from the egg; and Leuckart and Thomas nearly completed the story by giving us the history of the liver-fluke through the heteromorphic generations that begin with the embryo and end in the sexually developed fluke. Biehringer's recent paper supplements our knowledge of the sporocyst and its brood in one or two important particulars.[1]

Structure of the sporocyst.—The typical sporocyst is composed of three layers: 1. The outer thin layer, for a long time regarded as a cuticle and sometimes compared to the basal membrane of planarians, is shown by Biehringer to contain nuclei, and hence it must be regarded as a true epidermis, comparable with the *hypodermis* of other worms. Hitherto the ciliated mantle of the embryo, which is thrown off during the transformation into a sporocyst, has been held to represent the entire ectoderm (epidermis), and hence the sporocyst was supposed to be without an ectodermic layer. Biehringer takes a more rational view, holding that the ciliated mantle represents only the outer layer of the ectoderm, comparable to the outer epithelial layer of the larva of an echinoderm or a nemertine. The so-called cuticula of the cercarian larva is also shown to be not a cuticula but an epidermis.

2. Beneath the epidermis there is a thin muscular layer consisting of an outer stratum of transverse (circular) fibers and an inner stratum of longitudinal fibers.

3. The inner layer, which forms the chief part of the wall of the sporocyst, may be called a *germinal epithelium.*

Some sporocysts have a fourth layer enveloping the three just named; but this layer, as was long ago pointed out by Leuckart, forms no part of the proper wall of the sporocyst. Biehringer has for the first time determined the precise origin of this accessory membrane. *It is formed from the blood corpuscles of the host.*

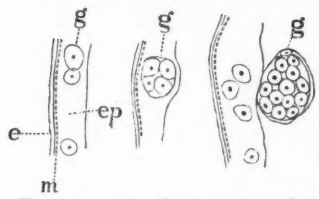
Origin of the Germ-cells of the Sporocyst.—There is a wide difference of opinion between Leuckart and others as to the origin and nature of the cells which give rise to the young brood in the mature sporocyst. The free-swimming distomian embryo is completely filled with coarsely granular cells, which are the direct

[1] Joachim Biehringer. Beitrage zur Anat. u. Entw'gesch. d. Trematoden. *Semper's Arbeiten*, VII, 1884, pp 1-26.

descendants of the cleavage-cells. Leuckart holds that these are the germ-cells of the next generation, and that their number remains the same when the sporocyst stage is reached. Thomas also regards these as germ-cells, but thinks that their number is augmented by germ-cells derived from the epithelial layer which lines the cavity of the sporocyst. According to Leuckart then the germ-cells are ready formed from the outset; but according to Thomas some are ready formed while others have an epithelial origin.

Biehringer has settled definitely that germ-cells do arise in the epithelium, but leaves the question of a two fold origin of germ-cells still open, not having been able to trace the history of the cells which fill the interior of the embryo.

A cell in any portion of the epithelium divides into two cells, the plane of division cutting the axis of the sporocyst at right angles, as in Fig. 1 *g*. Further division gives four, eight cells, &c., ending in the formation of a morula-like mass which escapes from the epithelial layer into the central cavity, and here completes its development. This mode of reproduction is to all appearances asexual, and may be regarded as a process of internal budding. The developmental cycle of the trematode is therefore, according to Biehringer, a true alternation of generations.



FIGS. 1, 2 and 3 show portions of the wall of a sporocyst with epithelial cells (*g*) in different stages of cleavage. *e*, epidermis; *ep*, epithelium; *m*, musculature; *g*, germ-cells developing.

THE DEVELOPMENT OF THE JAWS OF BRANCHIOBDELLA AND A METHOD OF ISOLATING THEM.[1]—The jaws, of which there are two, one dorsal and one ventral, are formed on small papillæ as cuticular secretions. The papillæ represent slightly thickened areas of the epithelium lining the œsophagus. The jaws then are merely thickened portions of the general cuticula which covers the whole of the external surface of the worm as well as the epithelium of the œsophagus.

The five or more denticles on the lateral and posterior edges of the jaw are each the product of a single cell which is slightly longer than the other cells of the papilla.

In order to isolate the jaws and with them the entire cuticular mantle, it is only necessary to leave a Branchiobdella in an empty watch-glass until it has dried, and then cover it with water. The cuticula will expand to its original size, leaving the shrunken animal inclosed as in a sack. The sack can then be cut through the middle and the animal easily removed by slight pressure with the aid of a small brush. The jaws will then be seen cohering with the œsophageal portion of the cuticular sack.

[1] Walter Voigt. *Semper's Arbeiten*, VII, pp. 47 and 54-55, 1884.

SCIENTIFIC NEWS.

— We have received a description, by Professor Alfred C. Haddon, of an apparatus for demonstrating systems of classification. What he proposes is very simple, merely consisting of a series of glass plates placed vertically over one another, leaving a small space between each, and a number of small movable blocks. The exact method for supporting the glass plates is of no consequence, and may be varied to any extent. The apparatus which he employs "consists of an oblong mahogany board, let into the corners of which are four brass sockets; into these are inserted four brass standards which are pierced with holes at regular intervals in such a manner that the holes in each end-standard are *vis à vis* with those of its fellow, and are at the same time parallel with those at the opposite end. Through these holes brass wires are inserted, and it is upon these that the glass plates rest. This apparatus has the advantage of being readily taken to pieces, and being quite portable. The names should be printed on paper, then cut out and pasted on two faces of oblong blocks of wood in such a manner that they can be read in a front view or by looking down vertically upon the apparatus. A makeshift may be constructed by bending a small oblong piece of cardboard roofwise and writing the name on one face of the anticlinal. The several blocks may be linked together in the same plane by pins placed either vertically or obliquely, and reaching to the upper glass plate. Any complicated system of linkage is thus possible.

"In a classification of recent forms, each plate might represent a stage of differentiation, and the arrangement of the forms on that superficies would indicate their inter-relationships. The lower planes would naturally be chosen for the less differentiated types. An area on each plane could always be made by a colored line to represent some special modification. Degraded animals might be tinted, and a black pin slanting from the higher to the degenerate form would graphically show that it was not an ascending type. Missing links between more or less widely separated living animals could be appropriately supplied by names within brackets.

"For phylogeny the arrangement would be somewhat similar except that each plate would represent some geological horizon, the name of which would be on a block placed in one corner. Every name in each geological epoch should be tinted in some distinctive color, so as to distinguish at a glance its precise horizon.

"The philosophical palæontologist arranges the names on each plane so as to indicate the relations of each animal to those preceding and succeeding it in time, as well as to its synchronous neighbors, and thus he gets a graphic view of the march of life; by looking from above down the vista of time he sees widely separated recent animals gradually converging till they all unite in

some form which, if at present unknown, must once have existed; or, more accurately, diverging from such a common ancestor. It will also be made apparent that in every age there were forms which varied from the parent stem which lived for a longer or a shorter period and then became extinct.

"Very valuable museum demonstrations could be made by fitting up a comparatively large apparatus to the glass plates of which were cemented real fossils with their names. Ammonites and Brachiopods, for instance, are well fitted for this purpose. Affinities and variations would in this case be illustrated by the actual specimens, and so be vividly impressed upon the mind."—*Proc. Royal Dublin Society.*

— The Ottawa Field Naturalists' Club evinces its activity in promptly issuing its Transactions, Vol. II, No. I. The club has for four years maintained a strictly local character, and to this is ascribed whatever success it has attained. The subjects treated refer to the local flora of Ottawa, the sand plains of the Upper Ottawa, the fossils of Ottawa, edible and poisonous fungi, a list of the Coleoptera of Ottawa, and the deer of Ottawa valley, with reports of the different branches or sections into which the society is subdivided. If every city in America had such a local, enterprising society, and there are a few which have, what an increased interest in and respect for the study of nature would pervade our people! Its effects would be seen in our common schools; it would ameliorate the degrading materialism of our times, tone down the love of display and lavish expenditure in moneyed circles, and here and there give room for the growth and development of trained observers of nature.

— The records of the Society of Naturalists of the Eastern United States, vol. I, part I, Boston, 1884, contains the constitution and by-laws with a list of members; a copy of the original call for the organization of the society; with the records of the first meeting at Springfield, Mass., and the second meeting at New York, Dec. 27 and 28, 1883.

— A department of veterinary medicine and surgery has been recently established in connection with the University of Pennsylvania. Dr. R. S. Huidekoper has been placed in charge.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

AMERICAN ASSOCIATION FOR ADVANCEMENT OF SCIENCE, Philadelphia meeting, Sept. 4–11, 1884.

SECTION E—GEOLOGY AND GEOGRAPHY.

The geological age, character and origin of the gypsum beds of Cayuga county, N. Y. S. G. Williams.

The correlation of the lower coal measures of Ohio and Eastern Kentucky. Edward Orton.

On a section of the strata of Cretaceous and Tertiary formations of Alabama. Eugene A. Smith and L. C. Johnson.

On some fish remains recently discovered in the Silurian rocks of Penna. E. W. Claypole.
The horizons of petroleum and inflammable gas in Ohio. Edward Orton.
A review of the geology of Delaware. Results of a survey now in progress. Frederick D. Chester.
The saltwell at Humboldt, Minn. N. H. Winchell.
Geographical and physical conditions as modifying fossil faunas. H. S. Williams.
On some large and peculiar fossil fishes from Ohio and Indiana. J. S. Newberry.
On the geological survey of New Jersey. Geo. H. Cook.
The chemical erosion of limestone of the Appalachian system. A. S. Ewing.
Deep-sea sounding in the Caribbean sea. J. R. Bartlett.
The profile of Nicaragua, geographical and commercial. Capt. Bedford Pim, R.N.
The pilot chart of the North Atlantic ocean. J. R. Bartlett.
Metamorphism in the Huronian of the Northwest. R. D. Irving.
Identification of the Green Mountain gneisses in Eastern New England. C. H. Hitchcock.
Notice of a new and very important work on the origin of the crystalline schists, by Dr. I. Lehman. Geo. H. Williams.
Occurrence of boulders of decomposition and gneiss at Washington, D. C. J. W. Spencer.
A great trap dyke across Southeastern Pennsylvania. H. Carvill Lewis.
A study of *Eozoon canadense*. Alexis A. Julien.
The second geological survey of Pennsylvania. Chas. A. Ashburner.
A brief account of the remarkable explorations in Thibet, Mongolia and the frontiers of India and China, recently made by Kreshna, or A. K., a native surveyor, trained under the Trigonometrical Survey of India, with official map. Trelawney Saunders.
New identifications in biblical geography, based on the recent survey of Western Palestine, made for the Palestine Exploring Fund, with the great map of the survey and the reduced map of the Old Testament, Apocrypha and Josephus, derived therefrom. Trelawney Saunders.
An attempt to determine the amount of chemical erosion taking place in the limestone (Calciferous to Trenton) valley of Center county, Pa., and hence applicable to similar regions throughout the Appalachian system. A. S. Ewing.
On the relative level of the Atlantic ocean and Gulf of Mexico, with remarks on the Gulf Stream and deep-sea temperatures. J. E. Hilgard.
Recent improvements in apparatus and methods of sounding ocean depths. Daniel Ammen.
Sketch of the life and scientific work of Dr. Arnold Guyot. Wm. Libbey, Jr.
On the intimate relations of the Chemung and Waverly groups in the N. W. portions of Pennsylvania and S. W. part of New York. James Hall.
On the Eurypteridæ of the Devonian and Carboniferous systems of the U. S., with a supplementary note on a species of Stylonurus. James Hall.
British earthquakes and their seismic relations. Richard Owen.
Geographic classification, illustrated by a study of plains, plateaus and their derivatives. W. M. Davis.
On the ultimate results of converting the basin of the Desert of Sahara into an inland lake. P. H. Vander Weyde.
Note on Cassiterite from King's mountain, N. C. Chas. W. Dabney, Jr.
North Carolina phosphates. Chas. W. Dabney, Jr.
Native antimony from Prince William parish, York county, New Brunswick. Geo. F. Kunz.
A study of one point in the archæanpalæozoic contact line in S. E. Pennsylvania. Persifor Frazer.
Evidences of local glaciers in the Cattskill Mountain region. John C. Smock.
Sand boulders in drift at Columbia, Mo. J. W. Spencer.
The Missouri coteau and its moraines. J. E. Todd.
Cause of motion in glaciers. Chas. Whitlesey.
The genesis and conservation of volcanic energy. J. W. Pike.
Exhibition of a geological map of the U. S., and a geological map of New York, New Jersey and Pennsylvania. J. W. Powell.
On the physical conditions of the interior of the earth. H. Hennessy.
Musical sand, its wide distribution and properties. H. C. Bolton.

Musical sand, its wide distribution and properties. H. Carrington Bolton and Alexis A. Julien.
Notice on the microscopical examination of a series of ocean, lake, river and desert sands. Alexis A. Julien and H. Carrington Bolton.
On the erosive action of ice. J. S. Newberry.
Additional facts concerning the glacial boundary in Kentucky, Indiana and Illinois. G. F. Wright.
Deflections in the direction of the iceflow in Maine during the last part of the glacial epoch. O. H. Stone.
On two series of Kame or Osar gravels which appear to cross each other like an X. Geo. H. Stone.

SECTION F—BIOLOGY.

On Ctenacanthus and Gyracanthus from the Chemung of Pennsylvania. E. W. Claypole.
On a special function of the external third of the lenticular nucleus of the corpus striatum. Charles Porter Hart.
Observations upon the amphibian brain, from a comparison of Amphiuma, Menopoma and Menobranchus. Henry F. Osborne.
Fertility in hybridization. R. B. Roosevelt.
On the skin of insects. C. S. Minot.
Hibernation of the lower vertebrates. A. W. Butler.
The development of Limulus. J. S. Kingsley.
Do the cerebellum and oblongata represent two encephalic segments or only one? Burt G. Wilder.
On the morphology and evolution of the tail of osseous fishes. John A. Ryder.
On the mammalian affinities of the saurians of the Permian epoch. Edward D. Cope.
On finger muscles in *Megaptera longimana* and in other whales. John Struthers.
Some observations on the influence of oxygenated and unoxygenated blood, as well as of blood in various degrees of dilution on the isolated heart of the frog and terrapin. H. G. Beyer.
Affinities of Dionæa. Jos. F. James.
Biological problems. C. S. Minot.
A botanical study of the mite-gall found on the petiole of *Juglans nigra*, known as *Erineum anomalum* Schw. Lillie J. Martin.
The habits of some Arvicolinæ. Edgar R. Quick and A. W. Butler.
The existence and dorsal circumscription of the portæ (foramen of Monro) in the adult human brain. Burt G. Wilder.
The relative position of the cerebrum and the cerebellum in anthropoid apes. Burt G. Wilder.
Observations on the phylogeny of the Artiodactyla Mammalia, derived from American fossils. E. D. Cope.
The torsion of leaves. W. J. Beal.
The fossil flora of the globe; historical view. Lester F. Ward.
The fossil flora of the globe; geological view. Lester F. Ward.
The fossil flora of the globe; botanical view. Lester. F. Ward.
Influence of isolation upon vegetation. E. Lewis Sturtevant.
The hood of the hooded seal (*Cystophora cristata*). C. Hart Merriam.
Remarks of delegate from the Ornithologischer verein in Wien. C. Hart Merriam.
Polarity of leaves of *Erigeron canadense*. W. J. Beal.
On some points in the development of pelagic teleostean eggs. George Brook, Jr.
The dynamics of the insect-crust. Geo. Macloskie.
Some questions in anatomical nomenclature. Burt G. Wilder.
Experimental researches on the so-called thought transference. W. F. Barrett.
Alleged sensory effects of magnetism. L. F. Barrett.
On the presence of eyes and other sense organs on the shells of Chitonidæ. H. N. Moseley.
Utricularia vulgaris with young teleostean fishes entrapped in the bladder-traps of that plant. H. N. Moseley.
Feathers of the Dodo. H. N. Moseley.
Experimental research relating to the etiology of tuberculosis. Geo. M. Sternberg.

Preliminary note on the lymphatics of the common bull-head (*Amiurus catus*). F L. Kilborne and S. H. Gage.
On the nervous system of Comatula, with observations on the mutual affinities of the recent group of Echinoderms. A. Milnes Marshall.
Stomata on seeds. Geo. Macloskie.
Structure and development of suspensory ligament in the horse, ox and sheep. D. J. Cunningham.
Ethidene dichloride as an anæsthetic. John G. McKendrick.
The influence of cross-fertilization upon the development of the strawberry. Wm. R. Lazenby.
On the extinction of species. Thomas Meehan.
On the hitherto unknown mode of oviposition in the Carabidæ. C. V. Riley.
Larval theory of the origin of tissue. Alpheus Hyatt.
Objections to some commonly accepted views of heredity. Alpheus Hyatt.
Structure and affinities of Beatricea. Alpheus Hyatt.
Structure of the siphon in the Endoceratidæ. Alpheus Hyatt.
Researches on growth and death. Charles S. Minot.
The osteology of Oreodon. W. B. Scott.
Vesiculæ seminales of the Guinea pig. C. S. Minot.
A new parasitic Copepod from the clam (*Mya arenaria*). R. Ramsay Wright.
Preliminary notes on the delicacy of the special senses. E. H. S. Bailey and E. L. Nichols.
The adventitious inflorescence of *Cuscuta glomerata*. C. E. Bessey.
On the identification of the animals and plants of India which are mentioned by ancient Greek authors. V. Ball.
The comparative longevity of the sexes. Mrs. A. B. Blackwell.

SECTION G—MICROSCOPY.

On the reproduction of short standards of length. Wm. A. Rogers.
On some new microscopic devices. R. H. Ward.
Recent studies on the theory of the microscope and their practical results as regards the use of the microscope in scientific investigations. R. Hitchcock.
On some points in microtomy. John A. Ryder.
Upon a microscopic method of studying the amphibian brain. Henry F. Osborne.
Histology of Lingula. H. G. Beyer.
Description of the Schröder camera lucida. R. Hitchcock.
Demonstrations of perforations in the cellulose walls of plant-cells. Louis Elsberg.

SECTION H—ANTHROPOLOGY.

Upon the evolution of a race of deaf-mutes in America. A. Graham Bell.
Formation of Iroquois words. Erminnie A. Smith.
The occurrence of man in the Upper Miocene of Nebraska. Edward D. Cope.
The lineal measures of the semi-civilized nations. D. G. Brinton.
A search in British North America for the lost colonies of Northmen and Portuguese. D. G. Haliburton.
Some characteristics of the Indian earth and shell mounds on the Atlantic coast of Florida. Andrew E. Douglass.
The manner in which Indians made their stone implements. P. R. Hoy.
The sacred pipes of friendship. Frank LaFlesche.
Some observations upon the usage, symbolism and influence of the sacred pipes of friendship among the Omahas. Alice C. Fletcher.
Interviews with a Korean. Edward S. Morse.
Remarks on North American races and civilization. E. B. Tylor.
Some parallelism in the evolution of races in the old and new world. Daniel Wilson.
The use of the plough in Japan. Edward S. Morse.
The three culture periods. J. W. Powell.
The sacrificial stone of San Juan Teotihuacan. A. W. Butler.
The different races who built mounds in Wisconsin. Stephen D. Peet.
Etymology of the Iroquois word Rha-wen-ni-yu. Erminnie A. Smith.
Evolution of animal life illustrated by study of emblematic mounds. Stephen D. Peet.

Eastern archery. Edward S. Morse.
Uses of the emblematic mounds. Stephen D. Peet.
Notes upon some quartz objects from Central Minnesota. Miss F. E. Babbitt.
The importance of the study of primitive architecture to an understanding of the pre-historic age in America. Stephen D. Peet.
Local weather lore. Amos W. Butler.
Disputed points concerning Iroquois pronouns. Erminnie A. Smith.
Archæological explorations by the Peabody Museum of American Archæology and Ethnology, communicated at the request of the trustees of the museum. F. W. Putnam.
Description of the skeletons and skulls found in the large mound of the Turner group. Miss C. A. Studley.
Mythology of the Wintuns. J. W. Powell.
On the geographical distribution of labretifery. W. H. Dall.

SECTION F—ECONOMIC SCIENCE AND STATISTICS.

The principles of graphic illustration. Franklin B. Hough.
On the credit of the United States Government. E. B. Elliott.
The future of the United States. J. B. Martin.
The structure and economic value of some of our woods. P. H. Dudley.
Lands in severalty to Indians. Illustrated by experiences with the Omaha tribe. Alice C. Fletcher.
Condition of deaf-mutes and deaf-mute instruction in the United States, statistically considered. J. W. Chickering, Jr.
Production and distribution. Edw. Atkinson.
Upon the expediency of a proposed "new departure" in the form of schools for the education of deaf mutes. Joseph C. Gordon.
On indexing the literature of science. B. Pickman Mann.
Percentages and costs of nutrients in foods. W. O. Atwater.
Irregularity in railroad building a chief cause of recent business depressions. William Kent.
Some experiments in a new method of land cultivation by the use of dynamite, and the important results obtained. George W. Holley.
The apprenticeship question and industrial schools. Thos. Hampson.
The learned professions and the public. 1870–1880. Chas. Warren.
The aims and methods of manual training schools. C. M. Woodward.
On the application of the historical method to questions in economic science. T. B. Browning.
A new resource for the women of the United States. Silk culture. Lorin Blodget.
Some economic and social effects of machinery. Edward T. Peters.
A discussion of the principles involved in the general action of vegetation and of trees especially to prevent extremes of temperature. James Hyatt.
National identity in its economic aspect. Lorin Blodget.
Brief outlines of the investigations upon the power to move railroad trains and the mechanical inspection of railroad tracks, as made by the dynagraph and track inspection car. P. H. Dudley.
An account of the first general census of India. Trelawney Saunders.
The uses of great expositions. Lyndon A. Smith.
American production for American consumption. J. R. Dodge.
A review of the proceedings of the section of economic science and statistics at the Montreal meeting B. A. A. S. Chas. W. Smiley.
Commercial relations of the United States with Spain and her colonies. His excellency Don Arturo de Marcoartu.
The American pearl. Geo. F. Kunz.
The philosophy of criminal development. Lewis W. Haupt.
An illustration of the results produced by the artificial propagation of fish. Chas. W. Smiley.
The education of pauper children, industrially and otherwise. James O. Bevan.
On technical education in the British Islands. Henry Hennessy.
Natural scheme of high culture in the U. S. of America. Knut Forsberg.

